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ARCHÆOLOGY.

DI CESNOLA'S DISCOVERIES AT CURIUM.

Since the year 1866, Gen. Di Cesnola, who was one of New York's distinguished soldiers in the late war, has been exploring the ancient ruins of the island of Cyprus, and four years ago created a high degree of interest and enthusiasm among students and artists by exhibiting, first in England and afterwards in New York, where it was purchased by the trustees of the Metropolitan Museum, a large and varied collection of Cyprian antiquities, which he had brought from the ancient site of Gotgos.

During the ten years of his labors, Gen. Di Cesnola has made excavations at more than thirty different points, making discoveries of greater or less interest and importance to the historian and archæologist, having identified the sites of not less than nine or ten ancient cities which had passed out of the memory and recognition of the world, and discovered the sites of as many as seven ancient towns whose names are as yet unknown. In the latter part of 1876 he arrived in London with another most rare and valuable collection of gold, silver and bronze relics, taken from some subterranean chambers discovered and explored by him at Curium, in 1875. Having failed to sell them to our British cousins, he offered them to the trustees of the Metropolitan Museum, at New York, for $60,000 in gold, an offer which they promptly accepted and secured the amount within a few

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days by the voluntary subscriptions of zealous and munificent friends of that institution: thus effecting the completion of a unique gallery, which is the finest in the world, and exciting the envy of the old world *savans*.

Harper's Weekly, of January 13, 1877, contains Gen. Di Cesnola's report of his work for the year 1875, which is so interesting that we give nearly the whole of it, in his own peculiar phraseology:

"In the report I sent last year to the Museum I said that probably I would undertake further explorations at Salamis; consequently early in this spring I went there with my diggers for that purpose. According to Porphyrius, Meursius, and other authors, before the arrival of Teucer there existed a city named 'Korona;" and the Greek hero, according to these authors, after the Trojan war, when banished by King Telamon, his father, from the kingdom of Salamis, came to Cyprus with his followers, took possession of 'Korona,' rebaptized it 'Salamis,' and made himself king over it.

"After some weeks of explorations I found nothing which would warrant further excavations at that place.

"In my opinion it will be very difficult hereafter and extraordinary to make any discovery of importance at Salamis, for the reason that I have assured myself that there very extensive excavations have been undertaken at different epochs and for various purposes.

"Under the Lusignan kings, according to a Cypriote writer, excavations were made and continued for nearly two centuries, both at Salamis, Constantia, and elsewhere, in search for architectural remains and sculptures with which to decorate the royal palaces of these Crusader kings; in fact, at Amathus, Cilium, Curium, the two Paphos, and Salamis, great many tombs are visible to-day which were explored very probably at that period. Wherever I explored I convinced myself that others had visited those localities long before me, and therefore I gave up diggings at Salamis.

"More or less the same thing may be said of Constantia, entirely leveled to the ground by the 'Lion-hearted' King Richard, though the city was already for more than a century in decaying condition, and with very few inhabitants. Her building material was used under the Venetian Republic to repair and strengthen the walls of Famagosta, in anticipation of that long siege which she had to sustain from the Turks, and which sealed her fate and that of this island.

"From Salamis, always coasting the sea, I took the direction of Larnaca. In the vicinity of Cape Greco, which Strabo calls 'Pedalium,' I had my tents pitched for several days. East of this promontory, some twenty minutes' walk from it, I discovered the site upon which once existed the city of Leucolla; she owes the honor of being recorded by Strabo for no other reason but for that of having accidentally given the name to the great naval battle fought near her harbor by Demetrius and Ptolemy (B. C. 306).

"Beyond Cape Greco, and always along the sea-shore, after many unsuccessful attempts I succeeded at last to recognize and identify the exact site whereupon was built a Greek city called 'Throni,' which Strabo men-

tions in his book as if by accident, but leaves us in doubt whether he intended to speak of a city or of a promontory. This spot is called at the present day by the inhabitants 'Torno,' and lies between Cape Greco and Cape Pyla.

"During my pedestrian perambulations in that neighborhood, at the very extreme point of Cape Pyla, not far from the ruins of a circular tower of mediæval construction, at an elevation of about one hundred feet from the sea, I discovered by mere chance a long cavern excavated twenty-seven feet in the rock, which I had the curiosity to enter. To my surprise I found in it a great mass of petrified bones, the larger portion of which appeared to me to be human. They adhere so tenaciously to the walls and pavement of the cavern that it may be said they form an integral part of them. After two hours of hard labor with iron tools we succeeded in detaching a few pieces; some I sent to the Royal Academy of Sciences of Turin, of which I am a member, and the remainder has been packed up in one of the boxes sent to our Museum in New York. A few days later I was conducted to see another such cavern, smaller in size, and only forty minutes' walk from the former. There, also, are great many petrified bones adhering to the pavement, and apparently of the same period of the others. The Christian peasants of the neighborhood are convinced that the bones are those of thirty Christian Greek martyrs. Every year in the month of March they go in procession, headed by their priests, to this cavern, in order to pray on these 'prehistoric bones.'

"On my return to Larnaca, by the desire and at the request of Professor John Ruskin, of London, I superintended some excavations made at Soli for his account; they lasted, however, but a few months, and with the exception of some three or four statuettes, some heads, and several vases, the result has not been brilliant. At Soli, in order to find good things one must remove first from the surface of the soil many tons of earth brought down from the neighboring mountains by the annual rains, and which has accumulated upon those ruins to the height of several yards; and this preparatory work would be both expensive and unprofitable for several months.

"Amathus (called by the Latin poets Amatunta) was one of the oldest Phœnician cities of Cyprus. It was built on the crest and southern slope of a rocky hill, neither very high nor very large, and detached from several others which surrounded it. Traces of a pier, now under water, are still visible near the sea-shore. It was surrounded by a thick wall, the foundation of which I met on the northeast side of the hill after digging a few feet below the surface of the ground. Remains of another wall are also seen around that hill at different places, but it is of a more recent construction than the other, and is probably Byzantine work.

"On the summit of the eminence a French archæologist, Count de Vognè, in 1862, visiting the island, took possession, in the name of France, of an immense stone vase, which is now deposited in the Louvre Museum. Fragments of another similar vase still exist, and are lying a few feet from

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the spot where the other was for many years standing, and in view of every passer-by.

"Although in the southern slope of the hill of Amathus there are great many tons of stones which have once served to the construction of ancient buildings, yet very seldom are found among these débris any architectural or sculptured remains.

"Nevertheless, during my absence from Cyprus, in 1873, fragments of a colossal statue, cut out of the calcareous stone of the island, were exhumed there. Its style is very archaic. The head has a beard trimmed after the Assyrian fashion. It holds a lion without a head by the hind-legs. It has all the appearance of being the titulary divinity of Amathus, namely, 'Melkart,' the Phœnician Hercules (probably used at a later period for decorating a public fountain, as the head of the lion was cut, and a square hole pierced through the neck of the animal for the introduction of a metal pipe). After great deal of official correspondence between the British consul at this place, who pretended to have claims upon that monument, and the Governor-General of the island, the latter got the best of the argument, and at a cost of nearly $500 in gold it was shipped to Constantinople, and is now deposited in the 'Imperial Ottoman Museum of St. Irene.'

"At Amathus there are different localities where tombs abound, but the greater portion lie along the sea-shore. These tombs are oven-shaped, and excavated in a sandy soil at a depth varying from three to five feet. Most of them contained but one body. The objects therein discovered were glass, always broken, but with beautiful iridescence (this being generally the case when the tombs are near the sea), terra cotta lamps of the first and second century of our era, large amphoræ similar in shape to those found at Pompeii; seldom gold ornaments of any value.

"Another kind of tombs are those, cut in the rock, on the adjacent hills west of Amathus. They are oblong, and cut horizontally in irregular tiers; none are over seven feet in length, and the majority of them measure scarcely six feet. They were all opened centuries ago.

"The third group of tombs is situated in a field northeast of Amathus, encircled by low hills, forming, as it were, a natural amphitheatre, and contain sarcophagi made either of white marble imported from abroad, or of calcareous stone of this island.

"These sepulchres are all built with finely cut stones, and are the handsomest I have discovered in the island. I examined many of them. They are found by digging at a depth of forty to fifty-five feet below the surface of the ground, and it is quite difficult to get at them, as the entrances of these tombs are not all facing in the same direction. Some of them have but a single room, others have two, and some four. Their chambers are all built with large stones, some measuring twenty feet in length, nine feet in width, and three feet in thickness. But their average size is the following: length, fourteen feet; width, seven and a half feet; thickness, two feet.

"These tombs are of two different shapes; one with a flat roof and

square walls like the following sketch, the roof in every instance being composed only of three large slabs; and the other, with the roof in the form of what we call in the American army a "wall tent." These tombs, the construction of which must have cost a large amount of money and much labor, probably belonged to the royal and aristocratic families of Amathus. Those of but one room have always one, often two, and sometimes three, sarcophagi inside. When with one only, it is invariably found placed in the centre of the room; when two they are placed to the right and left of the entrance, with their heads toward the wall. When three are found inside, two are placed, as before stated, to the right and left, and the third one near the wall, opposite the door.

"The position of the sarcophagi inside these tombs never varies, whether the latter have one, two or four chambers. In one composed of two rooms, for instance, I found as many as ten sarcophagi. Four sarcophagi were deposited in the first, and six in the second room. Their position was exactly as described before, with this difference, that the five extra sarcophagi were superposed to the other five. All were made of calcareous stone, without any ornament.

"No tombs were discovered with more than four rooms; and of these only two, one of which contained the sculptured sarcophagus of which I sent a photograph to the president of the Metropolitan Museum. The sculptured sarcophagus was in the centre of the inner room facing the entrance, and there lay in a heap, broken to pieces by the Vandals who, centuries ago, had opened this tomb, and being perhaps disappointed in finding the treasure they sought, wreaked their vengeance upon this rare gem of Oriental art and of pure Cypriote manufacture. Fortunately, however, the stone of which it is composed being soft, it is easy to restore it. In the adjacent chambers were two plain sarcophagi, both of which had suffered in like manner. The discovery of this tomb seems to have been due originally to mere chance, as an opening was found pierced through the roof, by which the descent was made.

"At what epoch this occurred it is difficult to determine, though some rude figures traced upon the walls seemingly with lamp smoke, and bearing in one case semblance to a knight, would indicate the presence of soldiers of the army of the Crusaders.

"The roofs of the four rooms are flat, and, as I said elsewhere, each is composed of three large stones. The first, or entrance chamber, is nine feet seven inches high, thirteen feet four inches long, and eight feet three inches wide. The tomb was discovered at a depth of thirty-nine and a half feet from the surface of the soil, the door facing the west. The three lateral chambers are each eight feet nine inches in length, seven feet ten inches in height, and eight feet two inches in width. The sarcophagi in all these tombs were placed on a very fine pavement of square stones, except in one tomb, in which I discovered a beautiful sarcophagus of fine white marble, having sculptured upon it a female head of colossal proportions in

early or archaic Greek style—something like the one existing in the museum at New York, but with the difference that this is much finer in every way, and is Greek. In this case the sarcophagus was elevated from the ground, and stood supported upon six flat stones.

"Before leaving Amathus for Curium the removal of this sarcophagus occupied considerable of my time and thought, as with the means at my disposal it was a very difficult undertaking. We were possessed of no pulleys or other machinery for raising such weight, and were obliged, therefore, to rely solely upon ropes and hand force. Ten hours were employed in bringing it to the surface of the ground. It was then placed upon a low cart made expressly for that purpose, and thence dragged slowly by eight oxen and twenty-six men over rough fields strewn with stones.

"Curium was built, like Amathus, on the summit of a rocky elevation, some 300 feet from the level of the sea.

"The Argives, according to Strabo, were the first inhabitants of Curium. After having selected that excellent situation, they cut the rock perpendicularly on the south and east sides in such a manner that at a short distance one believes to be opposite a huge mediæval castle in ruins.

"At the base of the rock, and on the slope of the adjacent hills, there are great many rock-cut tombs, some hemispheric, others like square sepulchral chambers, which have been opened centuries ago.

"The city of Curium, besides having been built, like an eagle's nest, upon an almost inaccessible eminence, had still a Cyclopean wall on the crest of that hill, which formed a belt around the city.

"Curium had three entrances. Those on the south and west sides are yet quite visible; that on the north has disappeared. The most important of these entrances seems to have been the western one, which faced the sea and the fine bay of Curium, because, unlike the others, it was flanked by two square towers, which apparently defended it, as their foundations are connected with those of the Cyclopean wall above named. I had all the débris removed from one of these for the purpose of measuring its foundations. I found them almost square—twenty-five feet by twenty-four.

"If a person enters these ruins from the south entrance, and takes a northern direction, after six or seven minutes' walk he will find himself face to face with a circular structure, which measures in circumference 720 feet. It has to me all the appearance of having been a theatre. In its immediate vicinity a great mass of stones and rubbish covers small square foundations of buildings divided by a street thirty-seven feet wide. There must have been the business portion of the city. The area occupied by Curium was much more extensive than that of Amathus, or 'Paloo Limissò,' as it is called at present by the inhabitants of Cyprus.

"With the exception of the ruins of 'Neo Paphos,' which are mostly Roman, there is no other place in Cyprus which shows upon the surface of the soil such a quantity of débris than Curium. I counted seventeen spots

whereupon there are columns, half buried, either of marble or granite, and which are lying there, very probably, in the same position in which they had fallen many centuries ago. Nothing is now seen standing; every thing lies prostrate by time. This city seems to have been destroyed by some convulsion of the earth. Many small mounds of rubbish mark the site of large private dwellings, while larger ones indicate that of public edifices and palaces. For nearly two months I have visited these ruins almost daily. I explored in preference some of those mounds which have columns lying around them, and from fragments of votive offering and statues, I am led to believe that they were small temples or shrines.

"One of these spots attracted more especially my attention. It had eight granite columns half buried near it. In having one removed, while excavating around it, I perceived that the column was lying upon a fine mosaic pavement inlaid with Assyrian and Egyptian patterns, such as the guilloche, the lotus flower, etc., a portion of which I have been able to save for our Museum.

"After all the columns had been removed, I perceived that the mosaic had been badly destroyed by some treasure hunter, who, after having dug about six feet beneath it, evidently gave up the work as unprofitable. I examined that place with great care, and I became convinced that it sounded hollow at several places, especially on the east side of the mosaic. In fact, after reaching the rock some twenty feet deeper, I found a subterranean passage cut in the rock eleven feet long, four and a half feet wide, and four feet high. At one end it must have had communication with the edifice above, though no traces are visible now. At the other end I found a door cut in the solid rock, closed by a stone slab, similar to those usually found in front of the Phœnician tombs in Cyprus. After the stone had been removed, I found an oven-shaped room filled with fine earth, which had percolated through the roof. In the process of removing this earth another doorway was discovered leading into another room, likewise filled to the top with earth. Informed by my chief digger of this occurrence, I descended into the first room to examine the place, and while poking with my foot-rule in a corner, in order to see at what profundity was the pavement, I found a gold bracelet, with several rings and ear-rings of the same metal, all in a pile, as if hidden there purposedly by somebody. This was extraordinary, for when gold ornaments are found in a tomb they are always mixed up with human bones. After this unexpected discovery I ordered the entire earth to be removed from both rooms. Such a thing is very seldom done here when the tomb is composed of one or two rooms only, because when they are found full of earth inside (and this, fortunately, is rather the rule than the exception), it adheres to the roof and walls so tenaciously that it requires a pickaxe to detach it; the diggers therefore prefer to tunnel each room on the right and left of the doorway, and search on the pavement for the contents of the tomb.

"However, in this case I insisted in having both rooms emptied; and

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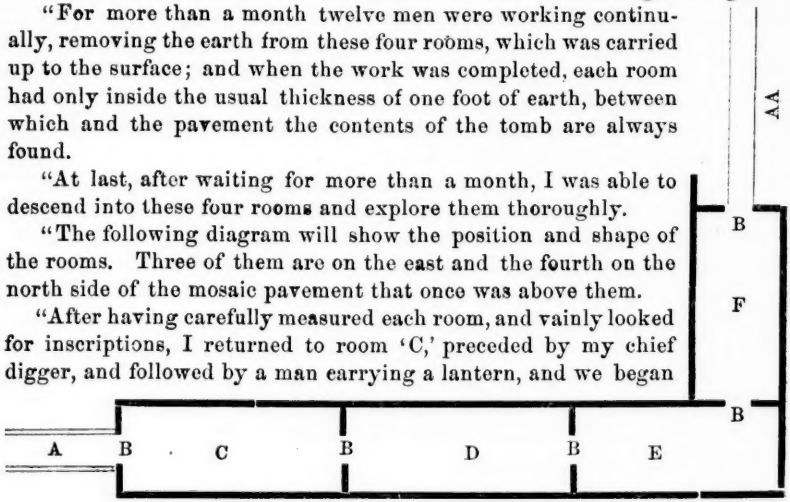
when the second room had some two thousand baskets of earth removed, a third doorway, and, of course, a third room, were discovered similar to the first two; and a week afterward a fourth room was still brought to light.

"For more than a month twelve men were working continually, removing the earth from these four rooms, which was carried up to the surface; and when the work was completed, each room had only inside the usual thickness of one foot of earth, between which and the pavement the contents of the tomb are always found.

"At last, after waiting for more than a month, I was able to descend into these four rooms and explore them thoroughly.

"The following diagram will show the position and shape of the rooms. Three of them are on the east and the fourth on the north side of the mosaic pavement that once was above them.

"After having carefully measured each room, and vainly looked for inscriptions, I returned to room 'C,' preceded by my chief digger, and followed by a man carrying a lantern, and we began



A, Passage facing the south, and leading to the rooms—length, 11 feet 4 inches; height, 3 feet 11 inches; width, 4 feet 10 inches. AA, Narrow passage facing west—height, 2½ feet; width, 2 feet. The length beyond 130 feet has been unexplored. B, Doorways communicating with the inner rooms. They measure alike—height, 2 feet 7 inches; width, 3 feet; depth or thickness of doorways, 1 foot 4 inches. C, D, E, Rooms or vaults. These three rooms measure alike—height, 14 feet 6 inches; width, 11 feet; length, 23 feet. F, Room—height, 14 feet; width, 9 feet; length, 21 feet.

the researches on that spot where, by accident, a month before I had discovered the gold ornaments aforesaid. The layer of earth was removed, my chief digger searching in it carefully and delicately with the point of his knife, and passing the earth twice between his fingers, like through a sieve. Soon afterward the mate of the gold bracelet was found, in company with two engraved rings and four pairs of ear-rings. I remarked then, for the first time, the total absence of human remains and of sepulchral vases, and I came to the conclusion that it was not and could not be a tomb. Some time afterward I found out that the building which once existed above these vaults was a temple, and these the subterranean repositories, wherein the priests or priestesses of the temple safely deposited the votive offerings and treasure of the temple during sudden invasion of the island, or in time of war. I was prepared, however, and satisfied, that whatever was to be found therein would be only that which, for some unknown reason, had been left behind. If that place had been found out by some treasure-hunter and ransacked, the stone slab would not have been replaced before the entrance door.

"My musings were agreeably cut short by a loud exclamation from my chief digger, who handed to me two large gold armlets weighing about

three pounds; but great was my pleasure when I saw upon each of them, beautifully engraved, an inscription in Cypriote characters. I ascended to the surface to examine them more carefully, and I found that both armlets had the same inscription.

"The Cypriote inscriptions found hitherto in the western part of the island are read from left to right, while all the others are read *vice versa*. The inscription on the armlets consists of thirteen letters, divided by a point into two groups, of which the first is the name of a king of Paphos, who seemingly offered the armlets to this shrine of Curium. In the present stage of Cyprian palæography, it would be hazardous to fix a date to this inscription, but from the character of other objects found with them, I am inclined to believe that the inscription on the armlets belongs to an epoch not later than the Persian expedition against Cyprus chronicled by Herodotus. This inscription, which clearly shows that the armlets were the 'votive offering,' or a present of a king of Paphos, confirmed me in my opinion that the building above with the mosaic pavement had been a temple of some importance. During the several days employed in searching room 'C,' I remained continually inside of it. Of the three persons therein I was the least excited, though there was a good excuse for it. At every moment gold ornaments were exhumed, and nothing else. Among them there were many signet-rings, with a movable scarabeus finely cut either in agate, carnelian, jasper, onyx, or other hard stones. Most of the representations engraved upon these scarabei are Egyptian and Assyrian. It would be too tedious were I to describe here one by one all the fine and valuable gold objects I found in room 'C.'

"Suffice to say that, with the exception of three little amphoræ in crystal (as rare and as precious as gold), all the other objects found in said room were of gold. In room 'D' the objects found therein were all silver, and they consist in vases, cups, bowls, pateræ, armlets, bracelets, rings, and earrings. Also a few Babylonian and Assyrian cylinders, three or four of which, with inscriptions in cuneiform characters. Room 'E' contained with the exception of a bronze lamp and a fine chariot in calcareous stone, many fine vases, with statuettes in relief, or with birds painted upon, and also two or three of the so-called Etruscan kind—one Kilis especially, and a Kalpis, are intact, and very fine specimens.

"Room 'F,' which is somewhat smaller than the others, has a doorway on its western wall, which leads to a narrow passage or tunnel, the end of which has been an impossibility for me to find. The foul air inside, the earth percolated through the roof, its narrowness, which does not permit to stand or to turn backward, render the thorough exploration of it a matter of utter impossibility. I entered it with the chief digger, each of us holding a light; but beyond 130 feet the lights went out, and, crab-like, we were obliged to come back, very lucky not to have remained suffocated inside.

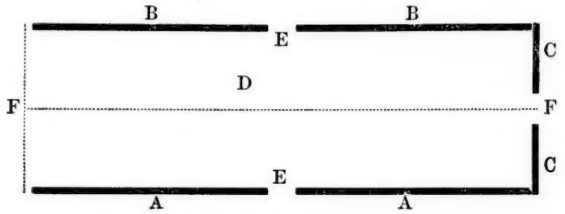
"I have mentioned this tunnel before describing the contents of room 'F,' for the reason that the latter was filled with earth removed from the

passage, and required several days before it could be explored. In this room every object found is of bronze, copper, and iron, and forms by itself a very interesting and valuable collection. There are many candelabra, some seven feet high, others less than a foot; lamps, mirrors, cups, bowls, vases, etc., etc.; bull's heads, birds, statuettes, etc.

"When I finished the thorough exploration of these four rooms I had the earth replaced inside, the ground above leveled as before (these being the conditions imposed upon me by the owners of the ground and by the imperial firman), and then I prepared to return to Larnaca with all my treasures.

"During the month in which my diggers were employed in removing the earth from the four rooms, I continued to explore superficially the ruins of Curium.

"North of this mosaic pavement, some fifteen minutes' walk, and outside the city walls, there are the ruins of a hippodrome, the walls of which are yet standing; at some places the height is yet twenty-two feet, while at others is scarcely six feet. The following diagram shows the form of the hippodrome (except that the closed end is rounded):



A, B, Sides of the hippodrome. C, End of the hippodrome. D, Axis of the figure. E, Gateways. F, Starting place of the horses and chariots.

"The entrance was facing the city; there are no more traces of the stalls for the chariots, and probably never existed, as I did not find any foundations there. No architectural remains or fragments of statues were discovered among the dèbris, which now fill the area inside.

"The whole length of the hippodrome is 1,296 English feet, measuring eighty-four feet in width. The three gateways measure alike eight feet in width. Compared to that of Olympia, this hippodrome was insignificant, its size being scarcely one-fourth of the former.

"Beyond the hippodrome, in a northwestern direction, at twenty minutes' distance, are the ruins of the temple of 'Apollo Hylates,' which I explored last year, and mentioned in my report. Near these ruins there is a promontory from which, Strabro says, the ancient priests used to throw into the sea those who touched the altar of Apollo with their hands. I visited it, and I am convinced that the victim was instantaneously killed.

"The entire collection consists of the following objects:

	Pieces.
Marble sarcophagus, with colossal head	1
Stone sarcophagus, full of sculptures	1

Gold, precious stones, cylinders, and scarabei	511
Silver and silver-gilt objects, Cyprus coins, etc	272
Objects in bronze, copper, lead, iron, and coins	440
Objects in alabaster, ivory, marble and serpentine	125
Egyptian, Greek and Roman lamps	555
Terra cotta statuettes—heads, groups, etc	800
Stone statues, bass-reliefs, heads, statuettes, etc	1150
Glassware—ointment cups, bottles, bowls, etc	750
Phœnician, Greek and Roman vases	2400
Cypriote, Phœnician and Greek inscriptions	45
Egyptian blue-glazed idols and armlets	110
Sundry articles—mosaic, etc	50

"My archæological labors in Cyprus are very soon terminated, and I hope before the end of next year to be able to leave this island.

"L. P. DI CESNOLA.

"LARNACA, December 23, 1875."

The London *Saturday Review*, in speaking of Gen. Di Cesnola's discoveries, says:

"The tale of the finding of the temple treasure at Curium is like a page from the 'Arabian Nights,' while the story of its brief stay in England is merely a repetition of passages too well known in the history of English collections. After selling his former collection to the trustees of the Metropolitan Museum, in New York, for some $60,000, Gen. Di Cesnola returned to Cyprus and began to excavate on the sites of various buried cities. Salamis, as he says in a letter to a contemporary, yielded him next to nothing, for the Princes of the house of Lusignan had been there before him. Curium seemed less promising; it was a town of which little is known. The Argives founded it, according to a rumor mentioned by Herodotus, though Stephanos of Byzantium holds out for a Phœnician or Syrian eponymous settler. Steasanor, the tyrant of the city, went over to the Persian side, as we learn from Herodotus, in the battle in the plain of Salamis. We also know that Curium was one of the places which furnished decorators and other artists to Esar-Haddon. It is impossible to say how it came to perish so utterly that Gen. Di Cesnola was among the first explorers who identified the site.

"The importance of Cyprus as a link in the history of art has for some years been fully recognized. One of the tributaries of Thothmes III, the island felt Egyptian influences before it came into the hands of Assyrians. Whether the Cyprians were originally a 'Japhetic race,' as Mr. Rawlinson calls them, or not, there were several early colonies of Greeks in the country, and Phœnician factories were not rare, while Greek and Phœnician merchants were constantly coming and going. Now the temple at Curium, if one may judge by the treasures, had been enriched by members of many races for a period of at least one thousand years. Few among the offerings can perhaps be proved to be later than the great golden bracelets which bear, in Cypriote characters, the name of Evandros, King of Paphos, in the

seventh century B. C. On the other hand, Assyriologists assign an almost incredibly early date to some of the cylinders, while the official seal of Thothmes III takes us back far enough in all conscience. How Curium fell, and by what means the temple treasure escaped being sacked, we do not know; but at all events it contains the history of the development of art through many centuries.

"The collection has not yet been definitely arranged with any attempt at chronological order, nor will it be in England. When the arrangement is made we shall expect to see the silver and golden bowls taking a prominent and instructive position. There is very little ancient silver in European museums—though, during the last week, much has been found at Mycenæ—because the metal becomes oxidized and of a dull clay color and of clay-like consistency. The peasants are rather in the habit of breaking any silver vessel they may find in digging, in the belief that they are worthless. The Curium treasure, however, includes many vases of elegant shape; but especially remarkable is one golden bowl, which is curiously decorated. Animals with an unmistakable resemblance to reindeer are scratched with much spirit in a band round the inside of the vessel. The style of treatment in another flat vessel is almost exactly that which may be seen in a curious Assyrian plate belonging to the Museum, and representing, as it seems, the visible world. The plate is full of slight elevations, which stand for mountains, and in each hill and valley the figure of a bear, lion or deer is scratched. The bowl from Curium is ornamented in the same style, and it is easy to agree with the theory of Brunn, illustrated lately by Mr. A. S. Murray, that Homer, in describing the shield of Achilles, had work of this sort in his mind. A more elaborate design in silver shows a hero struggling with a genuine Assyrian lion. In other vessels the characteristic ornaments of Assyrian and Egyptian art are, so to speak, interwoven. A mixture of this sort is apparently of the essence of Phœnician art. Homer is full of anecdotes of crafty Phœnician traders, who brought gold and silver work to towns on the seaboard of Hellas, and carried away kidnapped children and slaves. The early Greek designers would thus have the example of a style before them which, though somewhat bastard, and perhaps even debased, was free at least from hieratic restrictions. Cypriote art, on the whole, came nearer to that of the Etrurians than of any other race. It would be difficult to trace the exquisite dignity and comeliness of Greek art to anything learned from without, to anything but the divine gift of the spirit of beauty which transmuted the labored efforts of earlier people into perfection. Still the treasure of Curium does contain a wonderful collection of these efforts, the latest of which are touched with the spirit of Greece. In the immense variety of rings and of other jewelry the dawn of true Greek art may be discerned. Many of the rings are almost barbaric; they are gold circlets, with a revolving seal stone, or silver circlets which are so rusted that the stone can no longer be turned round. It is very curious that the finer the gem or intaglio the coarser and poorer is the

setting. The most beautiful gem is no doubt Boreas carrying off Oreithyla —'the most precious example,' says Mr. King, 'of Greek art just emerging from the archaic stage yet brought to light.' One of the feet of Boreas is slightly distorted, it seems, but we must remember that on the chest of Cypselus, according to Pausanias, 'snakes' tails hath he in place of feet.' This grotesque survival gives the chest of Cypselus an earlier date than the Cypriote ring, which indeed is clearly of later execution. Mr. King, whose eminent authority will be acknowledged, speaks in glowing terms of two other gems, which English students are to see no longer. Rings as many and glittering as those of Andvari's hoard in the Saga will be stored in the Metropolitan Museum of New York. As years roll on American ladies will learn that Phœnician is not the European way of pronouncing Venetian, and popular education will thrive immensely.

"We must confess that, though not so instructive as the gems, the necklets, armlets, ear-rings and fibulæ from Curium are even more attractive to the amateur of gold work. The Etruscans never beat the patient granulation which Cyprians lavished on morsels of gold, and we have never seen designs—those of Chimæræ and dragons, for example—so full of spirit and life. The little tortoises on studs are the prettiest of 'totems;' and, in fact it scarcely needs an educated eye to discern the manifold merits of the jewelry of Curium. The bronzes and sculptures have only been unpacked for a short time, and few people have had the good fortune to see them. Report speaks very highly of a sarcophagus, adorned with reliefs from the important myth of Medusa, which some Transatlantic scholar may elucidate at his leisure. The designs have been engraved in the *Revue Archeologique*, and nothing can be more curious than the mixture of Assyrian trees and beasts with thoroughly Greek warriors going to the chase in shields and helmets. The whole collection has been bought by the New York Museum for a sum of about £14,000."

The comments of the English press upon the refusal of the treasury department to ask parliament for the £10,000 demanded by Gen. Di Cesnola for this magnificent collection, are about equally divided between vain regrets at their own loss and rather cynical doubts as to whether the erudition and capability of American scholars are sufficient to appreciate such objects in the requisite degree. While there may be something of truth in this latter suggestion, it must at least be admitted that our movements in this respect are in the right direction, and that the beginning we have made and the zeal displayed by those making them, are the sure forerunners of that erudition, and the foreshadowings of æsthetic tastes which will, within a short time, be capable of appreciating fully even such exquisite and recondite treasures of ancient art.

XUM

THE STONE AGE OF NORTH AMERICA.

In the history of North America we can go back by the light of creditable documents to the year 986, when Biarne, the son of Bardson, set sail from Iceland, and, losing his way, came in sight of Newfoundland. Back of the earliest discovery by our race of this continent of North America must lie the history of the Indian. In Mexico traditional historic accounts take us back as far as the sixth century. And, for a still earlier time and its events, we have to penetrate the surface of this continent itself. The earth holds the further answers to these questions. In a story of ancient Greece, we read that there was a dispute as to whether Salamis had formerly belonged to the Athenians or the Megarians. When it was referred to Solon, he caused the graves to be opened. It was found then that their occupants were buried according to the custom of the Athenians, and not of the Megarians. The dead men settled that question. The testimony of the dead Athenians dispensed with the formula of an oath, and was yet accepted. No appeal was necessary after such evidence, just as no statute of limitation could bar a trial of such importance. It was a case of supplementary proceedings that commanded respect.

The earth of this continent shows us that before the Indians there has been a people whom we call Mound-builders—that is, mounds were thrown up here by men whose bones we find in them, lying among rough tools and utensils, and after the mounds we name the race, who, perhaps, were not a different people from the Indians.

But for these mounds we would not know of the men who built them. They are mentioned in no history, human or divine. What was there before the Mound-builder? I would speak to-night of what must have been long before *his* time—of *early*, though perhaps not *earliest*, man in North America. We must know this early man by our experience of his traces.

There was a time when stone-throwing was the occupation of grown men of our own race. Stones were used in the warfare of the Celt and the Roman. We remember that David, a Semite, used a pebble from the brook. And we shall find that men of other races, and before David, resorted to the same weapon for all the purposes which in David's time, and with his race, were partly served by metals. There is not only a parallel to be drawn between our boys and savages in certain ways, but there exists one between these boys of the present and our own men of the past. Just as, when cutting into the crust of the earth, we find the remains of animals and plants which once inhabited its former surfaces, the simpler forms below, the more complex above, so we find the remains of man's tools and implements in the clays and gravels of the last geological period of the globe, and with a like sequence in their character. The oldest and lowest forms of tools are simplest; the newer and nearer to the present surface, the more varied and complex. We have seen that the simplest weapon man could

use would be a stone. Even now a wagoner with broken cart looks around naturally for a stone to pound with, and so mend his ways. He picks up a stone on occasion as his ancestors did on most occasions. For the moment he is in the Stone age. And he uses what the earliest man must have undoubtedly used, a stone just as it is. There must have been a time when men picked up such stones as came in their way at the moment with which to throw at animals, to break their food, to injure their fellow-men. Such stones, unaltered by use, can no longer be identified.

It is easy to see how, through long lapses of time, men continued to select stones, with an ever-increasing care as to their shape and size. The best to fling, the surest to hit, the sharpest to cut, were picked out, assorted in leisure moments, stored for future use. The hunter, meeting with game, could find no stone suited to bring it down at the moment, and so came at last to carry this primitive shot about with him in his hunting. The way from such a process, and a mode of improving the best of these stones by an artificial changing of their shape and size, were clearly pointed out by experience. And there must have been a gain in the process to such an inventive tribe. No more were long searches for properly-sized stones necessary. By means of harder stones others were chipped and shaped, and so much time was gained from looking for stones and devoted to obtaining food. And tribes using artificially-shaped stones must have had a superiority over those who relied on what natural stones they found at the moment. They stood in less danger of starvation. In the absence of other remains, the presence of roughly-fashioned stones will be the earliest reliable trace we shall find of the existence of men. In Europe such stones have been found and described by several observers. In North America we owe their discovery to the zeal of Dr. C. C. Abbott, aided in funds for excavation by the Peabody Museum of Archæology, of Cambridge, Massachusetts.

North American rough-stone implements vary little in size and pattern, although, when we examine all the kindred rough-stone implements of the world yet known, we see that, as a class, they become gradually more determinate in their shape and the chipping more regular; they come more into the shape of spear-heads, and, perhaps, large arrow-points. Above the rough-stone implements we find those of polished stone; a departure showing that man was no longer satisfied with his first rude fashioning of his implements. Then we find the metals; and of these copper, being more pliable, is first beaten cold and worked into shape for use. Then the process of smelting and mixing with harder metals, such as iron, came to be employed; and to-day we are doing just what man has always done, improving our tools so that we may better our condition.—Prof. A. R. Grote, *in Popular Science Monthly for March.*

ANCIENT EARTHWORKS IN INDIANA.

Prof. R. T. Brown furnishes the Indianapolis *Journal* with the following account of the visit of the Archæological Society to the wonderful earthworks at Anderson, with a description of the formations:

"The Archæological Association of Indiana are indebted to the C., C., C. and I. Railroad for an excursion car placed at their disposal to visit the ancient earthworks of Madison County, Indiana. About thirty persons availed themselves of the invitation, and spent a day very pleasantly in examining the most curious and wonderful works of antiquity in the State. The earthworks are situated on a high bluff overlooking White River and the country beyond it, and but a few rods north of the Bee Line Railroad at a point three miles east of the City of Anderson. The ground is at present covered with a heavy forest of large trees, and is inclosed by a common rail fence. The principal work is a circular embankment elevated about eight feet above the earth on the outside, and measuring 320 feet in diameter. The earth-wall is sixty-three feet wide at the base, and has a level surface at its summit of about nine feet wide. The ascent from the outside is quite gradual, but when the summit is gained the descent is very steep to the bottom of a ditch eighteen feet below the top of the wall. This ditch is sixty feet wide at the top and encloses a circular plain 138 feet in diameter, in the centre of which is a mound four feet high and fifty feet in diameter. Looking to the south, a few degrees west, is a gateway, or opening in the embankment thirty feet wide, and a pass-way of the same width, and on a level with the original surface of the earth breaks the ditch and makes a level roadway to the inclosed plain and mound. On each side of this gateway the wall rises some two feet above its general level, while at the point directly opposite, for the space of about one hundred feet, the wall is gradually reduced in height about the same amount. The central mound has been opened in two places, but nothing of importance was discovered. A number of large trees are growing on the wall and in the enclosed space. A walnut tree had recently been cut down with a saw, leaving its stump on top of the embankment. This stump showed 217 annual rings, or growths. An oak tree one-third larger than this stands on the embankment, and the remains of a large walnut tree which had fallen, perhaps fifty years since, was observed at another point on the wall. The earth appears to be a sandy clay, with occasionally a pebble or small boulder enclosed. The circle is a perfect one, and the slope of the bank, both inside and out, is very regular and uniform. No modern engineer, with the advantage of our improved implements, could have made a more perfect job.

"Around this great work, at different distances from it, are small inclosures, some of them circular, others irregular in form, but all constructed on the general principle of inclosing a central space by means of an em-

bankment with an inside ditch and open gateway. In some of these the wall is as much as three feet high—in others the elevation is barely perceptible.

"Under the bluff, and near the margin of the river, a number of very strong chalybeate springs break out. These were probably the attractions which invited the unknown builders to this spot.

"About three-quarters of a mile east of this group of works is another large work differing somewhat in shape, but yet constructed substantially on the same principle. This is an imperfect parallelogram rounded at the corners and the two side lines slightly bent inward at the middle. The length of each side wall is one hundred and sixty feet, and the width of the space between them at the ends is seventy-five feet, and seventy feet in the middle. The earth-wall is about four feet above the common level, and twelve feet above the bottom of the ditch. The gateway at the east end of the inclosure is eight feet wide, and an embankment extends across the ditch at the level of the surrounding surface, making a roadway thirty-six feet long. On each side of the entrance of this gate, and at a little distance from it, stands a low mound, and several other imperfect traces of minor work to the south of this, in a cultivated field. Trees probably five hundred years old are growing on the large space inclosed by this work, and the decaying remains of several fallen oaks still larger were observed.

"It is in vain to conjecture when, by whom, or for what purpose these works, at an enormous expense of skill and labor, were constructed. Time and patient investigation may give us the clew.

GEOGRAPHICAL.

THE VALUE OF POLAR EXPEDITIONS.

In view of the very discouraging results of the British Arctic expedition under Captain Nares, some writers are beginning to question whether such expeditions do not serve to demonstrate the vitality, endurance and perseverance of the explorers rather than their ability to achieve the desired objects. Were the mere distancing others in reaching the goal of the geographical point called the North Pole and the settlement of the long vexed question of an open, or a palæocrystic, polar sea all that are to be accomplished by so great an expenditure of labor, money and human suffering, this view of the matter would be correct, and the sooner such explorations were abandoned the better. But these are the least important of all the results looked for by scientific men, who continue to urge the formation of

new exploring parties and fresh appropriations for their support. As will be seen by Professor Loomis' letter quoted from below, "there is scarcely a problem relating to the physics of the globe which can be fully understood without a knowledge of the phenomena within the polar regions." The poles and the equator are undoubtedly the most important points on the earth's surface for scientific observation. Meteorologists and astronomers, geologists and students of natural history all acknowledge this, and are eager to see the day when the bold navigators of some nation shall plant its standard on the land, water or ice of that mysterious Pole.

As is well known to all of our readers, Captain Howgate, of the Signal Service Bureau, U. S. army, has proposed a scheme for not only reaching the North Pole, but for making it a permanent point of observation in the future, or at least as long as such observations may be found desirable or valuable. Captain Howgate's plan, which has met with the approval of most scientific men of the day, consists in brief in planting a colony on the shore of Hall's Basin or Lady Franklin's Bay for a period of three years, during which time the party will learn how to live in an Arctic region, familiarize themselves with the country, the seasons, the movements of the ice and other phenomena which will enable them to select the most favorable time for making successful explorations. The scheme contemplates the erection of suitable buildings for the shelter of the party, proper supplies of food, apparel and such other articles as experience proves useful and necessary, to be furnished annually by vessels sent out for the purpose, the employment of certain Esquimaux as guides and hunters, and above all that the men comprising the party shall be energetic, hardy and experienced men, who are to be still further hardened by rigid and intelligent discipline by a competent naval officer and corps of assistants to take the observations and direct smaller expeditions from time to time.

Congress has been petitioned to permit the use of one of the smaller naval vessels and to appropriate the sum of $50,000 for the outfit and maintenance of the expedition, and it is probable that before another year passes the Howgate exploration party will be on its way to Discovery Harbor.

In opposition of the views of Captain Nares, who represents that a sea of ancient and never broken ice lies between the highest attained latitude and the Pole itself, Dr. I. I. Hayes, formerly surgeon to Dr. Kane, declares that the circumpolar sea is always open, that no large body of water like Baffin's or Hudson's bay is ever frozen over, even at the lowest temperatures, and he believes firmly that in 1861 he reached beyond the land belt of ice and with a boat could have gone to the Pole. He states positively that in the Arctics the temperature of the sea water generally remains at about 29°, but even at that temperature it does not freeze, unless the air is perfectly calm, and he further says: "I have seen waves rolling at 50° below zero without a particle of ice in sight."

Hiram J. Penrod, of the Signal Service Bureau, writes to the New York *Graphic* as follows:

"The severity of the climate has been exaggerated. To parties under cover it is not more trying than that at the summit of Mount Washington, in New Hampshire, or of Pike's Peak, Colorado, as stated by a former member of one of Dr. Hayes' expeditions, and who has since served a year on the summit of the last named mountain.

"In this connection attention is invited to the following extracts from official reports. The first is from the report of the Secretary of the Navy and his associates on the results of the Polaris expedition:

"'During the summer the entire extent of both low lands and elevations (at Thank God Harbor, latitude 81 deg. 38 min. north) are bare of both snow and ice, excepting patches here and there in the shade of the rocks. The soil during this period was covered with a more or less dense vegetation of moss, with which several Arctic plants were interspersed, some of them of considerable beauty, but entirely without scent, and many small willows scarcely reaching the dignity of shrubs.

"'Animal life was found to abound, musk oxen being shot at intervals throughout the winter, their food consisting of the moss and other vegetables obtained during this season by scraping off the snow with their hoofs. Wolves, also bears, oxen and other mammals, were repeatedly observed. Geese, ducks and other water fowls, including plover and other wading birds, abounded during the summer, although the species of land birds were comparatively few, including, however, as might have been expected, large numbers of snow partridges. No fish were seen. The waters were, however, found filled to an extraordinary degree with marine intervertebrata, including jelly-fish and shrimps. It was believed by the party that the seals depend upon the latter for their principal subsistence, the seals themselves being very abundant.

"'Numerous insects were observed also, especially several species of butterflies, also flies, bees and insects of like character.'

"In the last dispatch written by Capt. Hall, at his snow encampment on the north side of Newman's Bay, latitude 82 deg. 3 min. north, October 20, 1871, he says:

"'We find this is a much warmer country than we expected. From Cape Alexander the mountains on either side of the Kennedy Channel and Robeson Strait we found entirely bare of snow and ice, with the exception of a glacier that we saw covering about latitude 80 deg. 30. min., east side of the strait, and extending east-northeast as far as can be seen from the mountain by Polaris Bay. We have found that the country abounds with life and seals, game, ducks, musk-cattle, rabbits, wolves, foxes, bears, partridges, etc. Our sealers have shot two seals in the open water while at this encampment.'"

Having referred to the letter of Professor Loomis, of Yale College, to Capt. Howgate, we will close this article by quoting from it that portion in which he points out the almost inestimable advantages of a thorough exploration of the Arctic regions to the scientific and the commercial world.

"In order to estimate the value of the results of these expeditions we should consider what would have been the state of our knowledge of the physics of the globe if no such expeditions had been undertaken. There is scarcely a problem relating to the physics of the globe which can be fully understood without a knowledge of the phenomena within the polar regions. Whatever phenomena we may wish to investigate, it is of special importance to determine its maximum and minimum values, and in nearly all questions of terrestial physics, one or other of these values is found in the neighborhood of this pole. If, for example, we wish to determine the distribution of temperature upon the surface of the globe, it is especially important to determine the extremes of temperature, one of which is to be found near the equator and the other near the poles. If we wish to investigate the system of circulation of the winds, our investigation will be sadly deficient without a knowledge of the phenomena in the polar regions.

"If we wish to study the fluctuations in the pressure of the atmosphere, whether periodical or accidental, we cannot be sure that we understand the phenomena in the middle latitude unless we know what takes place in the polar regions. If we wish to investigate the currents of the ocean, we find indications of currents coming from the polar regions, and it is important to be able to trace these currents to their source. If we wish to investigate the laws of the tides we need observations from every ocean, and observations of the Arctic regions have a special value on account of their distance from the place where the daily tidal wave takes its origin. If we wish to study the phenomena of atmospheric electricity and of the auroral exhibitions, no part of the world is more important than the polar regions. If we wish to study the phenomena or terrestial magnetism, observations in the polar regions have a special value, since it is here the dipping needle assumes a vertical position, and the intensity of the earth's magnetism is the greatest. If we wish to determine the dimensions and figure of the earth, we require to know the length of a degree of latitude where it is greatest, and also where it is least. If we wish to determine how the force of gravity varies in different parts of the world, we require observations of the length of the second's pendulum, both where it is greatest and where it is least. In short, there is no problem connected with the physics of the globe which does not demand observations from the polar regions, and generally the poles and the equator are more important as stations of observations than any other portions of the earth's surface. If the information which has been acquired upon the various subjects in the numerous polar expeditions of the last half century were annihilated, it would leave an immense chasm which would greatly impair the value of the researches which have been made in other parts of the world.

"The subjects to which I have here referred are scientific rather than commercial, but many of them have an important bearing upon questions which affect the commerce of the globe. In the attempts which are now being made by the joint efforts of the principal nations of the globe to de-

termine the laws of storms, if we could have daily observations from a group of stations within the Arctic circle, it is believed that they would prove of the highest value in enabling us to explain the phenomena of the middle latitudes. Every winter upon the eastern side of the Rocky Mountains we find an intensely cold wave moving down from the northward, and spreading over a large portion of the United States. How can we fully understand the cause of the great changes of temperature which so frequently occur during the winter months, unless we know where this cold air comes from; and how can this be determined without fixed stations of observation extending northward even to the polar regions?

"The vast extension of the commerce of the world in recent times and its increased security are due in no small degree to more accurate information respecting the physics of the globe, including such subjects as the mean direction and force of the prevailing winds; the laws of storms; the use of the barometer in giving warning of the approaching violent winds; the surest mode of escaping the violence of a storm when overtaken by a gale; the most advantageous route from one port to another; the direction and velocity of the currents in every ocean; the variation of the magnetic needle in all latitudes, and its changes from year to year; together with many other problems; and most of these investigations have been greatly facilitated by observations which have been made within the Arctic regions. I do not regard it as an exaggeration to claim that the benefits which have resulted both directly and indirectly to the commerce of the world in consequence of polar expeditions are more than equal to all the money which has been expended on the enterprises.

"Is any additional advantage to the commerce of the world to be anticipated from further explorations in the polar regions? Undoubtedly. Precisely what these advantages may prove to be, we cannot certainly pronounce beforehand; but upon most of the questions to which I have already alluded more minute information is needed. The demands of science are by no means satisfied, and we may confidently anticipate that any advance in our scientific knowledge respecting questions connected with the physics of the globe will impart increased security to commerce. If a steamer starting from New York and traveling northward could pass directly over the North Pole through Behring Straits into the Pacific Ocean, it would be a triumph of geographical science, equal to the first discovery of America. Whether such a result will ever be witnessed we cannot safely predict, but past explorations have not shown that such an achievement is impossible. I hope we shall not rest contented while so much that is clearly feasible remains to be done, and until the northern boundary of Greenland has been traced."

RECENT GEOGRAPHICAL RESEARCHES IN THE EAST.

One of the most interesting results of the explorations recently made of ancient historical sites at the East—those, in especial, made memorable in Biblical association—is that presented by Prof. Conder, in his elaborate report on the cave of Adullam, a subject, as is well known, which has engaged the attention of oriental travelers and topographists for so many years and with such diverse conclusions.

Differing from almost all those who have preceded him in this line of investigation, Conder points out that the site of this celebrated cave must satisfy certain conditions in which the caves at Khureitun, the traditional site, and those of the Deir Dubban both appear to fail in one point or other. Adullam was in the Shephelah—it was, in fact, near Jarmuth and Socoh, between Gath and Bethlehem, and was a natural stronghold; its site must, therefore, show the usual indications of an ancient town with rock-cut tombs, good water supply and roads; must have at least one habitable cave, and the modern name must contain the essential letters of the Hebrew, especially the ain.

Singularly enough, Conder appears to be the first one to have ascertained that the conditions named are fulfilled in the site now called Ayd el Mieh, which lies in the upper part of the Wady Sumt or the Valley of Elah. In explanation of the conclusion to which this distinguished traveler has arrived concerning this long-controverted question, he states that on the western slope of the valley named is a place called after a kubbet known as the Wely Mudkor, the latter standing on the north edge of a range which rises five hundred feet above a valley, there a mile broad, the sides of the hill being steep and cut into terraces, and the kubbet surrounded by heaps of stones and ruins of indeterminate date; the rock is scarped and quarried; there are wells and stone troughs, ancient tombs, also roads connecting the place with Hebron, Bethlehem and Tell es Safiyeh, and the name Ayd el Mieh with an ain preserves all the essential letters of the Hebrew, which is a most important fact.

Now, as to the cave, Conder states that there is really no single cavern of vast dimensions and with winding passages, in this locality, as may be found at Khureitun, but a series of small caves, smoke-blackened and still inhabited, or used as stables, and he points out that the peasantry accustomed to live in caves carefully avoid living in those of large size, as being damp and feverish, as well as dreading the bats, scorpions and flies that infest them. If, therefore, this identification be accepted, the adventures of David assume a consistency and clearness not compatible with the character of the old traditional sites which have been described in history and located on maps.

Another important correction in Biblical topography, resulting from these recent researches, and which oriental scholars seem likely to accept as

at least plausible, is that which points out that the site— Bethnimrah—hitherto generally considered to be "the place where John baptised," is in fact too far south, one condition being that the place must be within two days' journey of Cana and Nazareth. Recently, all the fords of the Jordan have been examined, and, among them, is one found twenty-five miles from Nazareth, which not only seems to answer all the conditions, but also preserves the name—that is, it is called Makhadhet Abara, the "ford of the crossing-over;' but as Bethabara means the "town of the crossing-over," this identity of name might be met with at any of the fords, so that the identification must be supported on other grounds. Besides the favoring condition in respect to distance, the newly-found site is the ford over which the road down the Wady Jalud to Gilead and the Hauran passes; here the river bed is more open than at other places, the steep banks of the valley are further retired, and a broad space is left, suitable for the collection of the great crowds which followed John the Baptist, and for the performance of the rite administered by him to so great a multitude in one place.

Similarly favorable results appear to have attended the efforts recently put forth to arrive at some more satisfactory determination in regard to the ancient Ashkelon. It will be remembered that, a short time ago, Prof. Pusey, one of the most reliable authorities in matters of archæology, called attention to the fact that, just as there were a Gaza and a Maiumus Gazæ, or "Gaza by the Sea," so there were, in the sixth century at least, an Ascalon and a Maiumas Ascalon, each place having then a bishop of its own; and he also pointed out that Benjamin of Tudela speaks of the present Ascalon as the new town "built by Ezra the priest on the sea shore," four parasangs from the former place of the same name.

And now the interesting fact is brought to light that both of these Ascalons exist still. The ruined Ascalon by the sea shore has been long known and frequently described; but the site just discovered, called Khirbet Ascalon, is in the hills north of Beit Jibrin, near Tell Zakeriyeh. It shows remains of an early Christian church or convent, and a great lintel of stone with a deeply cut cross in the centre, rosembling somewhat the cross of Malta, lies on the ground; such lintels are to be found in all that class of ruins which date from the fifth to the seventh century. It is twenty-three miles from the shore, which would seem to agree with the four parasangs measured to Ashdod. From all the evidence gathered, it would appear, therefore, that the Ashkelon of the Bible, of Herod and of the crusaders, are one and the same place, distinguished from an early Christian site of the same name by the title of Ascalon Maiumas. The numerous crusading fortresses in the great plain which was the scene of so many terrible conflicts between the English and Saladin have also been pretty nearly all identified.

But the most valuable contribution lately made to this class of researches in Biblical geography is perhaps due to Porter, the English traveler, and in especial his investigations of the much-disputed site of Pisgah, upon which he throws some light of peculiar importance.

XUM

It was discovered by this traveler that the ruins of this memorable place lie on a gentle declivity which descends to the wild ravine of Ayun Musa, while on the south is a steep ascent to a rounded hill which projects boldly from the plateau of Moab and commands an extensive view of Western Palestine, and the name given by the Arabs to this hill is that of Jebel Siaghah, "Mount Siaghah"—a corruption of the Hebrew Pisgah, there being no P in Arabic, but the other radical letters of the Hebrew word are retained in Siaghah. Porter describes the summit of the hill as being a little higher than the table-land which extends up to it, rich in soil, and partially cultivated, a full view of Jeshimon, or Wilderness of Judea, being obtained from it, and the whole topography corresponding exactly with the Biblical narrative in Numbers. From the ruins of Siaghah he also saw, about due west, a round peak, connected with the northwest side of Jebel Siaghah by a low, narrow neck of land. On ascending the peak—some twenty minutes' travel from Siaghah, or a distance of about a mile—there were found the ruins of an old town covering the summit and sides of the hill, including, on the top, the remains of a Roman castle, with a large arched tank in the centre, now nearly filled with stones and broken columns, while outside the castle are ruins of a still older date. The name of both peak and town is Neba or Nebbeh, and the summit is about four hundred feet lower than Jebel Siaghah, but commands a much fuller view of the Jordan valley, the Dead Sea and the Plain of Jericho.

The fact appears to be unquestionable, according to Porter, that this Neba is the town Nebo mentioned by Eusebius as six miles from Heshbon, toward Jericho, a position exactly corresponding with that of these ruins; it is evident, too, from the Scripture narrative, that, in the time of Moses, Nebo was a town which gave its name to a section of the mountain-ridge beside it, and such is the case still. Porter states that he paid special attention to the view from Nebo, and compared it with that described in the account of the death of Moses. In the foreground, he says, far below, lies the whole plain of Jericho, with the valley of the Jordan on the northern shore of the Dead Sea, where the Israelites encamped, then called the plains of Moab; on the north is seen the range of Gilead, as far as its culminating point at Jebel Osha, the ancient Mizpah of Gilead, but all north of that peak, including Hermon, is shut out; on the northwest are visible, through the long vista of the Jordan valley, the heights of Naphtali and southern part of Lebanon; from thence to Hebron the whole outline of Western Palestine is in view, but no part of the Mediterranean is seen. It required but a half hour's ride from Neba, down a difficult zigzag path, to reach Ayun Musa, "the fountains of Moses," which spring up under a great cliff in the bottom of the wild glen to which they give their name; from this fountain the peaks of Siaghah and Neba are both in sight, and the interesting fact presents itself that, even to this day, the names Moses, Pisgah and Nebo still cling to this spot—indeed, it seems highly probable, from the observations made by this sagacious traveler, as well as from other concur-

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ring evidence, that these fountains of Moses, as they are termed, are identical with Ashdoth Pisgah, "the springs of Pisgah," mentioned in the opening portions of Deuteronomy. If this be so, it furnishes additional confirmation of the faithfulness of Porter's researches in this most interesting field of sacred topography.—*St. Louis Republican.*

THE ISTHMIAN CANAL.

Of all the points in the great Central American isthmus, reaching from Texas to Aspinwall, and dividing the two great oceans, the most desirable for the purpose of a ship canal is that surveyed a few years ago by a United States government expedition, and cutting across the isthmus of Panama at its southern extremity. It is very probable that a route via Lake Nicaragua or the isthmus of Tehuantepec would be cheaper and easier in cutting the proposed canal, but it either would be open to the objection of running a great distance through the territory of people that would hardly permit it to be neutralized or placed under the protection of the commercial nations of the earth, or free from toll, etc., for any lengthened period. The United States would hardly allow of a proposition to place a canal running through any portion of its domain under the control of foreign nations, and no other power can be expected to do this any longer than they are compelled by physical force so to do. Besides, the initiative has already been taken, and the right to cut the canal across the isthmus of Panama has been granted by the Columbian government to French capitalists, and the matter may be regarded as already started. The government of the Columbian Republic requires that it shall have no locks or tunnels, that it shall have a capacity of five to six thousand tons, that, in brief, it shall be a clear and perfect waterway between the two oceans. They also require that it shall be finished in ten years after the date of the formation of the company, and that it shall not cost over one hundred millions of dollars.

The value and necessity of such a canal is recognized all over the world, of which there is hardly a maritime nation that is not more or less interested in it. At present, vessels requiring to reach the Pacific from the Atlantic are compelled to go sixty-two degrees or 4,340 miles to the southward, more than most of them should, perhaps to double back just as far in their course, and then at last, not least, to round the tempestuous promontory of Cape Horn; or, as in the case of steamers, to thread the dangerous straits that divide the group of Terra del Fuego. There would, therefore, be not only a gain in shortening the passage, but also in the risk from fire, tempests, etc., to which vessels are ordinarily exposed, that would make this canal of the utmost importance to commerce. It would add greatly to the facilities for California commerce. It would shorten the distance to New York by 10,164 nautical miles; that is to say, it would reduce it by

two-thirds, and instead of an average voyage taking four months, it would not take more than six weeks. It would shorten the distance to Liverpool by 9,364 nautical miles, and reduce the time of passage to seven or eight weeks, whereas six or eight months are now sometimes taken.

The canal would enormously develop the business and industry of all central and southern South America, which has for so long a time been neglected, mainly on account of its inaccessibility from the centres of civilization, enlightenment and commerce. New and flourishing cities would spring up all along the border of the Pacific; Panama would become one of the great commercial centres of the earth and one of its greatest cities. New fields for the development of capital and the employment of labor would be opened, which otherwise might lie dormant for a quarter of a century. The annual amount of tonnage that may be expected to pass through is 3,000,000 tons, and this will increase rapidly from year to year, as a new way from Europe and the East will have been opened to the western parts of the great American continent, to the islands of the Pacific, Australia and New Zealand, Asia and the rich islands of the Indo-Chinese Archipelago. It will, in fact, be opening the Pacific ocean to civilization and commerce. As a business speculation there is no doubt but that the work would pay handsomely, nay, more than handsomely from the first, but if it never paid a cent and the expense had to be borne by the great nations of the earth, it is a work that should be accomplished.

For San Francisco and the Pacific coast it would, as we have already explained, inaugurate a new era as far as cheap freights and quick passages are concerned, but it would do much more than that. The founding of new towns and cities, the increase in the population of the old ones, and the new regions opened to civilization and commerce by it would be so many customers of ours, and in proportion as they grew so would this city grow too. San Francisco possesses a special interest in this matter, and her people look with eagerness for the inception of this marvelous undertaking which is destined, in a manner, to revolutionize the commerce of the world.—*Journal of Commerce, San Francisco.*

THE PROPOSED TERRITORY OF HURON.

The proposed new territory of Huron contains about 70,000 square miles and 10,000 inhabitants. It is the northern half of Dakota, and is said to embrace one of the best farming regions in the United States. The bill to create the territory has already passed the senate, and will probably pass the house, since there seems to be no serious objection to it. There being no direct means of communication between the northern and the southern portions of Dakota, people in the former section having business at Yankton, the capital, which is located in the southern part of the terri-

tory, are frequently compelled to travel hundreds of miles in the dead of winter. The capital of the new territory will be the young but rapidly growing town of Bismarck. Fortunately, at the suggestion of Senator Bogy, the name was changed from Pembina to the more euphonious one of Huron. The latter is an Indian name, while the former is a corruption of two French words.—*Washington Star.*

CHEMISTRY.

BOTH SIDES OF THE BLUE GLASS QUESTION.

In the issues of February 24th and March 3d, 1877, the *Scientific American* attacks the blue glass theories of Gen. Pleasonton in detail, and winds up by saying, "It is hardly necessary to add that in our opinion the use of blue glass, as advocated by Gen. Pleasonton, is devoid of benefit." In order to place the subject before our readers in its entirety, as elaborated and put forth by its assailant and defender in their best and most able manner respectively, we will give the objections proposed by the first and the answer thereto, as nearly in full as our space will allow, beginning with the *Scientific American:*

"On September 26, 1871, Gen. A. J. Pleasonton, of Philadelphia, Pa., obtained a patent for 'utilizing the natural light of the sun transmitted through clear glass, and the blue or electric (!) solar rays transmitted through blue, purple, or violet colored glass, or its equivalent, in the propagation and growth of plants and animals.' In his specification, of which the above constitutes one claim, he states that he has discovered 'special and specific efficacy in the use of this combination of the caloric rays of the sun and the electric blue light in stimulating the glands of the body, the nervous system generally, and the secretive organs of man and animals.' He also states that he finds that vegetation is vastly improved by the transmitted blue light.

"These alleged re-discoveries—for the General only claims to have devised the method of utilizing them—were extensively promulgated through the press early in 1871. Subsequently, in 1876, Gen. Pleasonton published a book on the subject, the volume being appropriately bound in blue and printed in blue ink. Recently public attention has again been called to the subject by a New York daily journal. The peculiar kind of glass in question is known as 'pot-metal blue,' that is, it is stained a bluish violet throughout, and is not clear glass covered with flashings of blue glass. It is used in greenhouses, etc., in connection with clear glass; and in Gen.

Pleasonton's grapery it appears that only every eighth row of panes was blue. Some of the results alleged to have been obtained by exposing animals and plants are as follows: Twenty grape vines, in their second year, after being set out under the blue glass, bore 1,200 pounds of splendid fruit. A very weak Alderney bull calf was in four months developed into a strong and vigorous bull. Heifers when kept under blue glass may safely bear young when eighteen months old. A weak child, weighing but three and a half pounds at birth, weighed at the end of four months twenty-two pounds—the light in this instance having come through blue curtains. Two major generals with rheumatism were cured in three days. A young lady whose hair had come out regained her tresses; and to these must be added various other cures of severe ailments which we have not space here to recapitulate. The above are the alleged facts; and we propose to consider the supposed discovery in the light of previous investigations.

"With reference to the theories of electricity, etc., advanced by Gen. Pleasonton to account for his phenomena, their absurdity is so complete that we shall waste no time over them. The important question in the matter, and the only one in which the public is interested, is whether or not blue glass is capable of producing all or any of the results imputed to its use. In order to clear the way for the examination of the investigations, the records of which we have carefully collected, let us consider first those which Gen. Pleasonton quotes in support of his views. These are (1) Seunebier's researches, which go to show that the blue and violet rays are the most active in determining the decomposition of carbonic acid in plants, and (2) experiments of Dr. Morichini, repeated by Carpa and Ridolfi, proving that violet rays magnetized a small needle. The first statement has been totally disproved. Dr. Von Bezold, in his recent work on color, states the 'chemical processes in plants, as far as they are dependent upon light, are principally caused by the rays of medium and of lower refrangibility. The development of the green color of the chlorophyll, the decomposition of carbonic acid, as well as the formation of starch, etc., in the grains of the chlorophyll, are induced by the red, green, and orange rays.' The blue, violet, and ultra violet rays, the same authority goes on to explain, influence 'the rapidity of growth, compel the so-called zoöspores to move in certain directions, and alter the positions of leaves,' etc. In confirmation of this, we have Sach's experiments in 1872, which show that light, transmitted through the yellow solution of potassium chromate, enables green leaves to decompose over eighty-eight per cent. of carbonic acid; while that passed through blue ammonia copper oxide decomposes less than eight per cent. This proves the superiority of the yellow ray to decompose carbonic acid; and this fact Prof. J. W. Draper discovered a long time ago by the direct use of the spectrum. In still further confirmation, we may cite the investigations of Vogel, Pfeiffer, Selim, and Placentim. The last three have conducted researches in full knowledge of those of Gen. Pleasonton, and their experiments show that yellow rays are more promotive of the evolution of

carbon in animals and its absorption in plants than any others in the spectrum, the violet rays having least power in these respects, with the exception of the red rays in the case of animals. The absorption of carbonic acid by plants, and its evolution by animals, we hardly need add, are prime essentials to the growth and health of each. The notion that light possesses a magnetizing power on steel was upset by Niepce de St. Victor, in 1861. After removing every source of error, he 'found it impossible to make one sewing needle, solarized for a very long time under the rays of light concentrated by a strong lens, attract another suspended by a hair, whether the light was white or colored by being made to pass through a violet-colored glass.'

"We can proceed further and even show that violet light is in some respects hurtful to plants. Cailletet for example says, in 1868, that 'light which was passed through a solution of iodine in carbonic disulphide prevents decomposition altogether.' Baudrimont says that 'no colored light permits vegetables to go through all the phases of their evolutions. Violet-colored light is positively injurious to plants; they absolutely require white light.' This scientist instituted the most elaborate experiments on the subject, ranging over eleven years, from 1850 to 1861; and the result of all his labor may be summed up in the simple statement that no illumination which human ingenuity can devise is so well adapted for promoting natural processes as the pure white light provided by the Creator. So much by way of general denial of the claims of superior efficacy residing in blue light of any kind.

"The spectroscope has clearly demonstrated that the violet glass acts purely as a shade for decreasing the intensity of the solar light. And in the simple fact that it does so serve as a shade lies the sole virtue (if any there be) of the glass. In 1856, Dr. Daubeny made experiments on the germination of seeds, and in his report is this suggestive sentence: 'In a south aspect, indeed, light which had passed through the ammonia sulphate of copper (blue solution), and even darkness itself, seemed more favorable than the whole of the spectrum; but this law did not seem to extend to the case of seeds placed in a northern aspect where the total amount of light was less considerable.'

"We now propose to finish our discussion by examining into the effects of light and darkness upon organisms. And we may especially here recall the fact that Gen. Pleasonton claims that not only does the blue light stimulate growth, but that it is a positive remedial agent for such severe ailments as spinal meningitis, nervous irritation and exhaustion, rheumatism, hemorrhage of the lungs, deafness, partial paralysis, shock due to severe contusion, and others, of all of which he cites cases.

"The theory that various colored lights exercise different effects on the human system is an old one. In 1831, Dr. Newbery of this city asserted that yellow light stimulates the nervous, pink the nutritive and blue the locomotive temperament; and recently Dr. Ponza, an Italian physician, has

asserted that lunatics are greatly affected by being placed in different colored rooms. Red light, Dr. Ponza says, removes feelings of depression, blue induces calmness, and by violet light a crazy person was in one day cured.

"It is a thoroughly demonstrated fact that light is an important vital stimulant; and that, if its operation be excluded, the development of the healthy bodily structure is arrested. Naturalists tell us that in the absence of light the transformation of a tadpole into a frog is stopped, and the reptile remains a tadpole. Plants in darkness become blanched and stunted in growth; the process of fixing the carbon in their tissues is arrested, a modification of the coloring principle takes place, and they appear white instead of green. The sad effects of deprivation of sunlight are especially observable among those who live in crowded alleys or cellars, or who work in mines, where the light of the sun seldom or never penetrates. The total exclusion of the sun's beams produces an impoverished and disordered state of the blood, emaciation, muscular debility, and the diseases due to imperfect nutrition.

"On the other hand, it is known that for certain purposes darkness or shaded light is advantageous to the bodily condition. Fowls, for instance, may be fattened much more rapidly in the dark, and it would seem that the absence of light exercises a very great influence over the power possessed by food in increasing the size of animals. It likewise seems to exercise a soothing and quieting influence, increasing the disposition of animals to take rest, making less food necessary, and causing them to store up more nutriment in the form of fat and muscle. Now, if the organism to be treated is subjected to light, all of which is filtered through blue violet glass, then, as we have previously demonstrated, it is in light which is considerably shaded. And very probably to this cause—and not at all to the peculiar hue of the light—is to be attributed the quieting influence on nervous and insane people which Dr. Ponza has remarked.

"But Gen. Pleasonton does not use blue-violet glass alone. On the contrary, he employs a combination of blue light and pure sunlight, the latter very much preponderating. In his grapery, for example, only every eighth row of panes is blue. The mingled light consequently is merely pure sunlight, very slightly shaded, and the animal or plant exposed simply takes a sun bath—the *solarium* of the ancients, who, knowing the vivifying influence of the sunbeams, had terraces built on the tops of their houses so that they might bask in them. This sun treatment is now frequently recommended by physicians for nervous diseases. Dr. Hammond, in one of his lectures, says: 'In convalescence from almost all diseases, it acts, unless too intense or too long continued, as a most healthful stimulant, both to the nervous and physical systems. * * * The delirium and weakness, by no means seldom met with in convalescents kept in darkness, disappear like magic when the rays of the sun are allowed to enter the chamber.'

"It is hardly necessary to add that in our opinion the use of blue glass, as advocated by Gen. Pleasonton, is devoid of benefit."

To this Gen. Pleasonton replies in the New York *Evening Mail* as follows:

"*To the Editor of the Scientific American:*

"In your issue for February 24, 1877, you have inserted an article entitled 'The Blue Glass Deception,' which is devoted to the facts, and their explanation in part mentioned in my book, recently published, entitled 'Blue and Sun-lights, their Influence upon Life, Diseases, etc.'

"There is nothing in my character or history which justifies in any way the application of the term 'deception' to me, on any subject whatever—and this term is a reflection on the character and conduct of the Commissioner of Patents, who issued to me the letters patent for my discoveries of the attributes of the *associated* Blue and Sun-lights—as it is also on the character and conduct of the Commissioner of Patents of the Dominion of Canada, who has issued to me similar letters patent for the same discoveries. As for the facts described in my book, the Commissioner of Patents of the United States satisfied himself of the truth of my recital of them by sending an expert from his bureau to investigate, who, after having devoted three days to their examination at my farm, made a most favorable report of his investigations on the subject, without which the letters patent would not have been issued. Nothing, therefore, can be truthfully said against the facts as I have published them in my book. As for the explanations that I have given of the causes that have produced those facts, it may be proper to state that it was only after having discovered that the accepted theory of physics with which I was acquainted could furnish no satisfactory solution of the problem involved in my discoveries, that I devoted myself to an examination of the subjects, and I have evolved the only theories with which I am acquainted that will explain them.

"Your critic has fallen into the same error that characterizes an article in Crooke's London *Quarterly Journal of Science*, of October, 1876, in which, after quoting the experiments of Prof. H. Vogel, certainly no mean authority on the chemical action of light, who states in his Chemistry of Light and Photography (p. 78), that 'recent observations have established that yellow and red rays, and not the blue and violet rays, produce the greatest effects on the leaves of plants,' he states that Dr. R. Hunt, in that well-known work, the Poetry of Science, fully admits that 'seeds under blue glass will germinate long before others exposed to ordinary daylight, whilst under the yellow ray the process of germination is entirely checked,' thus contradicting Vogel. But he resumes, 'if the experiment is continued, it will be found that under the blue glass the plants grow rapidly but weakly, and that instead of producing leaves and wood, they consist chiefly of stalks upon which will be seen here and there some abortive attempts to form leaves. When the process of germination has terminated, if the young plant is brought under the yellow light, it grows most healthfully and forms an abundance of wood, the leaves having an unusually green color from the formation of a large quantity of chlorophyl. Plants do not, however, pro-

duce flowers with readiness under this medium,' (now, if they do not produce flowers, how can they produce fruit?) 'but if, at the proper period, they are brought under the red glass, the flowering and fruiting processes are most effectively completed.'

"Was there ever anything so absurd as this statement of differences in the attributes of primary rays of light? You must, according to these scientists, use three different processes to produce a vegetable! 1. Plant your seeds under blue glass till they germinate. 2. After the germination, transplant the young plant and put it under yellow light, to get some stalks, branches and leaves, but no blossoms; and, 3, transplant again, putting the plants under red light, and you will have beautiful vegetables! And these discoveries are called science, and the revealers of them philosophers.

"In confirmation Mr. Hunt quotes a letter from Mr. C. Lawson, of Edinburg, an eminent seed merchant. This gentleman, as early as 1853, had proved the value of blue light in accelerating the germination, and employed it practically in testing the value of the seeds coming into his hands in the course of business. He found that seeds could be thus caused to germinate in two to five days, instead of, as heretofore, in eight to fourteen days; but he adds that he 'has always found the violet ray prejudicial to the growth of the plant after germination.' Now, in my experiments with seeds and plants under the associated blue and sunlights, which were commenced in April, 1861, I have obtained results which show that the germination of the seeds, the development of the leaves, branches and stems, the formation of fruit buds, their flowering and the subsequent maturity of the fruit, were all produced by the action of these associated lights. In the sixteen years during which my experiments have been conducted, my grape vines have every year developed a growth of fifty feet in the season of growth, maturing their wood, forming their fruit-buds for the ensuing season, and have been more healthy and vigorous than any other vines of which I have any knowledge. Last summer, an unusually hot season, I have been informed by Mr. Dreer, a very intelligent dealer in plants, seeds, etc., in this city, who visited, with some of the Centennial Commissioners from foreign countries, the principal graperies in this neighborhood, that the foliage in all of them that were visited was greatly burned and dried by the heat, while in mine the leaves retained their freshness and green color till the beginning of November.

"Mr. Crooke says: 'Here, then, is a complete discrepancy, and either Gen. Pleasonton on the one hand, or Messrs. Vogel, Hunt and C. Lawson on the other, must be decidedly mistaken;' and with a manliness that is highly commendable in a scientist, he continues: 'One point of difference between Gen. Pleasonton's arrangements and those of the European experimenters upon the influence of the various rays of light upon organic life is that the latter, ourself included, submitted plants and animals to the sole and exclusive action of blue, yellow or red light respectively, whilst in Gen. Pleasonton's experiments, the blue light has been used mixed (i. e. associated) in

certain proportions with ordinary daylight.' Mr. Crooke has thus found and appreciated the discovery. In Europe, they followed their own ideas, and failed. I followed, at an infinite distance, the plan of the Creator, who associates the blue light of the firmament with the sunlight in the season of growth to develop life on this planet. *Voita la difference.*

"Mr. Crooke proceeds: 'But if Gen. Pleasonton is in the right, the wonderful and salutary effects of blue light upon organic life are by no means the most extraordinary of its properties. Heat is also, in some *unaccountable* way, developed in the passage of sunlight through blue glass. * * It need scarcely be said that experimentalists have not found the blue and violet rays of the spectrum to be the hottest portions.'

"In quoting from my book, Mr. Crooke says: 'During the winter of 1871-2, which in this city (Philadelphia) was a very cold and rigorous winter, two ladies of my family, residing on the northern side of Spruce street, east of Broad street, in this city, who, at my suggestion, had caused blue glass to be placed in one of the windows of their dwelling, associated with plain glass, informed me that they had observed that when the sun shone through these associated glasses in the windows, the temperature of the room, though in midwinter, was so much increased that on many occasions they had been obliged, during sunlight, to dispense entirely with the fire which ordinarily they kept in their room, or if the fire was suffered to remain, they found it necessary to lower the upper sashes of their windows, which were without the blue glass, in order to moderate the oppressive heat.'

"Mr. Crooke concludes: 'We should feel much greater confidence in Gen. Pleasonton's observations if he had been content to place them before the world as novel, and if verified, important facts; but he goes much farther, and deduces from them an entire new philosophy. Into these, his doctrines, it will be early enough to examine when the action of blue light shall have been satisfactorily ascertained.'

"The moral of which is that it will never do to find out too many of nature's secrets at once, or to divulge them suddenly! Scientific nature can't stand it! Gently, General, or you overwhelm us!

"A writer has published in a Boston newspaper a notice of my book on 'Blue and Sunlights.' He is described as a scientist of great learning, practical experience and general intelligence. After slashing right and left, and condemning it *in extenso*, he explodes in denouncing it 'as a burlesque of science.' Though this expression is used in a sense intended to be derisive, I accept it, as Buffon, the naturalist, did, when Des Cartes ridiculed the famous story of the destruction of the Roman fleet in the harbor of Syracuse, by the burning mirrors of Archimedes, declaring it to be absurd and inconsistent with the science of Dioptrics, and yet Buffon repeated the experiment of Archimedes, so far as to set on fire combustibles at the distance of nine hundred feet with plane reflecting mirrors; or, as Cervantes, the celebrated author of the 'History of the renowned Don Quixote de la

duce flowers with readiness under this medium,' (now, if they do not produce flowers, how can they produce fruit?) 'but if, at the proper period, they are brought under the red glass, the flowering and fruiting processes are most effectively completed.'

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"Mr. Crooke concludes: 'We should feel much greater confidence in Gen. Pleasonton's observations if he had been content to place them before the world as novel, and if verified, important facts; but he goes much farther, and deduces from them an entire new philosophy. Into these, his doctrines, it will be early enough to examine when the action of blue light shall have been satisfactorily ascertained.'

"The moral of which is that it will never do to find out too many of nature's secrets at once, or to divulge them suddenly! Scientific nature can't stand it! Gently, General, or you overwhelm us!

"A writer has published in a Boston newspaper a notice of my book on 'Blue and Sunlights.' He is described as a scientist of great learning, practical experience and general intelligence. After slashing right and left, and condemning it *in extenso*, he explodes in denouncing it 'as a burlesque of science.' Though this expression is used in a sense intended to be derisive, I accept it, as Buffon, the naturalist, did, when Des Cartes ridiculed the famous story of the destruction of the Roman fleet in the harbor of Syracuse, by the burning mirrors of Archimedes, declaring it to be absurd and inconsistent with the science of Dioptrics, and yet Buffon repeated the experiment of Archimedes, so far as to set on fire combustibles at the distance of nine hundred feet with plane reflecting mirrors; or, as Cervantes, the celebrated author of the 'History of the renowned Don Quixote de la

Mancha,' did, when by it he destroyed chivalry and knighthood in Spain; or as Columbus did, when sailing in the Caribbean Sea, he discovered the islands off the coast of America, after having heard the gibes and jeers about his absurd schemes of a western route to the Indies; because my doctrines are destined to supersede all accepted theories, that cannot explain the phenomena that I have presented to the world.

"According to the experiments of Vogel, R. Hunt and C. Lawson, in order to get fruit or vegetables you must plant the seed under blue glass, to start them quickly, and when they have germinated there you must transplant the young plants under yellow glass, and, when their leaves are formed, you must again transplant them under red glass, and then you will insure a full development of the plant. How many crops would be raised by this process? And yet Vogel and Robert Hunt are among the most eminent scientists in Great Britain. Now I accomplish all these results by the association of blue and sun-lights, by passing through blue and plain glass.

"Now your criticism and that of Mr. Crooke in the first part of his article are based upon what you supposed to be the chemical action of light upon living organisms, which will not explain any of the phenomena that I have described, and hence actinism and the chemical theory must be abandoned. You will all have to adopt the electrical and magnetic theory that I have announced. You won't like it, but you will have to take it. It will be like going to school again to learn your alphabet.

"In conclusion, I may state that a gentleman of this city, Mr. Whitney, having some valuable plants which he wished to stimulate, *a la* Vogel and Hunt, directed his glazier to put yellow and green glasses in the windows of his house last fall, and in a short time he found them all dead, killed by those colors. He told me three days since that he had ordered these glasses to be removed and the blue glass to be substituted therefor. A French chemist has recently announced that the green and yellow colors are poisonous to and destructive of life.

"As you are a seeker after truth like myself, I would like you to explain why *the blue ray associated with white* light causes such wonderful results, and perhaps you may advance a theory more satisfactory than mine, and, if so, I will gladly adopt it."

THE ANALOGY OF SOUND AND LIGHT.

"The Saturday evening free lecture in connection with the Loan Collection of Scientific Apparatus at South Kensington was lately given by Professor Barrett, of the Royal College of Science, Dublin, on 'Some Experiments Illustrating the Analogy of Light and Sound.'

"The Professor commenced by referring to some of the well known facts about light and sound, such as that sound waves travel through air, while light waves travel through luminiferous ether, etc. Among many illustra-

tions of the rate at which each travels, he gave this as a very intelligible one: If a canon were fired in London the sound would take about eight minutes to travel to Birmingham, a little over one hundred miles, while in the same time the light from the flash would have traveled to the sun, a distance of over ninety millions of miles. But, though they so differ in the rate of progress, both light and sound show many phenomena in common.

"In the experiments made during the evening the sensitive flame was used as a detector of sound. This delicate acoustic reagent, familiar to London audiences through Professor Tyndall's lectures, was first, we believe, discovered in 1866, by Professor Barrett, though he modestly did not allude to the fact. Indeed, most of the experiments shown during the evening formed the subject of a paper read by him before the Royal Dublin Society in January, 1868, and the discovery of the ratios referred to at the end of the lecture was announced in the *Quarterly Journal of Science* for 1870. The performance of the experiments, however, was entirely new to a London audience.

"The analysis of the phenomena of light and sound were illustrated in the following order: 1. Both light and sound get feebler as they leave their source of origin. In the case of sound this was shown with a loud ticking watch and a sensitive flame. 2. In reflection the angle of incidence is the same as the angle of reflection. In the case of sound, this was shown with the sound of a whistle sent along a tube, and reflecting along another placed at an angle to it from a reflector placed at the end where they approached. The distance to which a feble sound might be reflected perceptibly from a concave mirror was shown with mirrors over thirty feet apart. 3. With refraction, in the case of light, familiar convex lenses were used; and in the case of sound, analogous but less familiar lenses of gas of a different density from air were used. A collodion balloon, filled with carbonic acid gas, served as a double convex lens, and its action was manifested by the concentration of sound from the ticking watch on to the sensitive flame. 4. Both light and sound suffer absorption in passing through non-homogeneous media. Professor Tyndall's apparatus, showing the 'echoing back' of sound in passing through successive alternating layers of gas of different densities, is now well known, and every one is familiar with the fact that, though light may traverse a vessel of clear water, it can no longer travel when it is filled with bubbles of transparent air. 5. There is an analogy between the sympathy among the same notes of a gamut and the sympathy among individual colors in the spectrum. An incandescent body that produces a particular bright band in the rear of the spectrum will, when in a gaseous state, absorb light, and cause a dark band in exactly the same part of the scale. Tuning forks, wires, or columns of air in jars are responsive to vibrations produced by others exactly in unison, but only to those. This was shown in various ways in a very clear manner. 6. An analogy, which Professor Barrett called a more fanciful one, was spoken of. All the complex music of an orchestra is the result of a few simple notes variously

combined. So all the tints of a picture are the results of a few simple colors variously combined. The musical scale sorts the complex notes in one case, the spectrum sorts the complex colors in the other. Professor Barrett, taking Professor Listing's determination of wave lengths, has made a most interesting comparison. The wave lengths of the notes of the gamut he expresses not in absolute but in relative measurement. Thus C is taken as 100, and all the other notes have their wave lengths expressed in percentages. Similarly, red is taken as 100, and the wave lengths of other colors are expressed in percentages. This interesting result comes out in comparing the two columns; D and orange are each 89; E and yellow 80; F and green, 75; G and the average of the blues, 67; A and violet, 60; B and ultra violet, 53; C and the obscure rays (black), 54. Further, the comparison of harmonies comes out in an interesting manner. Low C and upper C sound well together, so red and black go well together. Red and green, or C and F, harmonize well; but red and orange no lady would wear, and C and D make a combination by no means pleasant. Red and blue, or C and G, also go well together. 7. The concluding part of the lecture was devoted to an illustration of the figures described by vibrating bodies. Several apparatus for this purpose were briefly referred to, but especial attention was given to an apparatus of great ingenuity devised by Mr. S. F. Pichler. Professor Barrett showed it with an electric light and a reflection on to a screen. The principle of it may be thus described: Two metallic vibrators, each with a small speculum, are fixed at right angles to each other, and sounds are produced by a current of air acting on one or both of them at pleasure. The perpendicular vibrator is tuned to a given note; the horizontal vibrator is fitted with a mechanical arrangement whereby its pitch can be graduated to any degree of nicety within the compass of two octaves. An apparatus is also provided whereby a pencil of light is concentrated upon the speculum of the perpendicular vibrator, whence it is reflected to the speculum of the horizontal vibrator. For lecture purposes artificial light is used, which is further reflected and magnified upon a screen. When musical sounds are produced by the vibrators, various luminous geometrical figures are formed on the horizontal speculum and reflected on the screen by the single or joint action of the vibrators described by the pencil of light; and the form and motion of such figures demonstrate the exact relations to each other of the musical notes produced. Sounds which harmonize to the ear produce regular figures to the eye, as, for example, segments of the circle, ellipses, ovals, circles, or straight lines; and if the amplitude of each vibrator be equal, these luminous figures will hover on the speculum or screen with an apparent steadiness like that of the heavenly bodies hovering in the sky. If the sounds do not harmonize, the figures are confused, unsteady and complicated, presenting an appearance as if the wave lines were contending with each other. The mathematical relations of musical notes are also demonstrated, regular simple forms being produced by combination of those notes which result from vibrations bearing

a definite numerical ratio to each other, while irregular and unsteady figures are caused by notes which have no such ratios. The pattern made on the screen by a discord is very bewildering to the eye.

"Professor Barrett, in concluding, said: 'After seeing how musical notes may be translated into moving lines of light, the words put by our poet into the mouth of Lorenzo have additional interest.

"'There's not the smallest orb which thou behold'st
But in his motion like an angel sings.'"

Major Festing conveyed the thanks of the audience to Professor Barrett.—*London Times.*

ASTRONOMY.

THE NEW SUN AND ITS DISAPPEARANCE.

The phenomenon of the appearance of a new star in the heavens is rare enough to arouse the greatest interest among astronomers and other scientific persons. It is not merely an occurrence appalling in its mystery and immensity; but even in the minds of those accustomed to contemplate the majesty of other worlds, it tends to arouse questions of the gravest importance relative to the physical and chemical constitutions of the stars, and to the comparison of our own sun with other far distant ones.

On November 24th last, M. Schmidt, Director of the Observatory at Athens, Greece, at 5h. 41m. in the evening, saw a star of the third magnitude in the constellation *Cygnus*. No record of the existence of any such star was in existence. No such star was visible on November 20th; but whether it appeared on one of the intervening days between that date and the 24th, M. Schmidt cannot say, as cloudy weather had then prevailed in Athens. The news was at once telegraphed throughout the world, and the astronomers watched the new star gradually wane until, on December 8th, it was scarcely of the sixth magnitude.

By comparing the observations of the discoverer, M. Schmidt, with those of M. Prosper Henry, we find two important facts: First, that within eight days the star diminished from the third to the fifth magnitude; and, secondly, that the color changed from a marked yellow to a bluish green. On December 2d, spectroscopic observations at different observatories were made; and the general conclusion was that the spectrum, being formed in large part of brilliant lines, was that of an incandescent vapor or gas. On December 4th, M. Cornu obtained a very satisfactory observation, which enabled him to identify three lines as the lines C, F and 434 of hydrogen.

XUM

A fourth appeared to him to correspond to the line, D, of sodium, and another with the characteristic line, *b*, of magnesium. Finally, two lines, of which the wave lengths are 531 and 451, appeared to coincide, one with the famous line 1474 (Kirchoff's scale), observed in the solar corona during eclipses; the other with a line of the chromosphere.

It thus appears that the light of this new star is exactly the same in composition as that of the solar chromosphere; and thus we are told that the new comer is a sun, doubtless in general respects like our own, which has met with some great catastrophe whose cause we cannot at present determine, but whose real nature is unmistakable.—*Scientific American.*

"Our sun," says Prof. Proctor, commenting on the phenomenon, "is one among hundreds of millions, each of which is probably, like it, the centre of a scheme of circling worlds. Each sun is rushing along through space, with its train of worlds, each bearing perhaps, like our earth, its living freight, or more probably each, at some time or other of its existence, becoming habitable for a longer or shorter period. Thus the suns may be compared to engines, each drawing along its well-freighted train. Accidents among these celestial engines seem fortunately to be rare. A few among the suns appear suddenly (that is in the course of a few hundred years, which in celestial chronometry amounts to a mere instant) to have lost a large part of their energy, as though the supply of fuel had somehow run short. Mishaps of that kind have not attracted much attention, though manifestly it would be a serious matter if our own sun were suddenly to lose three-fourths of his heat, as has happened with the middle star of the Plow, or ninety-nine hundredths, as has happened with the once blazing, but now scarcely visible, orb called *Eta* in the keel of the star-ship *Argo*. But when we hear of an accident of the contrary kind—a sun suddenly blazing out with more than a hundred times its usual splendor—a celestial engine whose energies have been over-wrought, so that a sudden explosion has taken place, and the fires, meant to work steadily for the train, have blazed forth to its destruction—we are impressed with the thought that this may possibly happen with our own sun. The circumstances are very curious, and though they do not show clearly whether we are or are not exposed to the same kind of danger which has overtaken the worlds circling around those remote suns, they are sufficiently suggestive.

"Now, a point to which I would call special attention, is that all the elements of the catastrophe, if one may so speak, which has befallen the remote sun in the Swan exists in our own sun. At times of marked disturbance parts of our sun's surface show the lines of hydrogen bright instead of dark, which means that the flames of hydrogen over those parts of the sun are hotter than the glowing surface of the sun there. We have all heard, again, how Tacchini and Secchi, in Italy, attributed some exceptionally hot weather we had a few years ago to outbursts of glowing magnesium. And, lastly, our sun is well supplied with that element, whatever it is, which gives the bright line of its corona during eclipses; for we now know that

the whole of the streaked and radiated corona occupying a region twenty times greater than the globe of the sun (which itself exceeds our earth one million two hundred and fifty thousand times in volume) belongs to the sun. Again, though the sun has shone steadily for thousands of years, yet, so far as can be judged, the stars which, like this one in the Swan, have burst out suddenly, blossoming into flames of hydrogen, within which the star's heart core glows with many hundred times its former heat, have also been for ages shining steadily amid the star depths. We know that the one which blazed out ten years ago in the Northern Crown was one of Argelander's list, a star of the tenth magnitude, and that, after glowing with eight hundred times its former brightness for a few days, it has resumed that feebler lustre. We have every reason which analogy can furnish for believing that the new star, which was not in Argelander's list, simply escaped record by him on account of its faintness. It is now fast losing its suddenly acquired lustre, and is already invisible to the naked eye. It appears, therefore, that there is nothing in the long-continued steadfastness of our sun as a source of light to assure us that he, too, may not suddenly blaze forth with many hundred times his usual lustre (the conflagration being originated, perchance, by some comet unfortunately traveling too directly towards him). Though he would probably cool down again to his present condition in the course of a few weeks, no terrestrial observers would be alive at any rate to note the fact, though the whole series of events might afford subject of interesting speculation to the inhabitants of worlds circling round Sirius or Arcturus. Fortunately we may legitimately reason that the risk is small, seeing that among the millions of suns which surround ours, within easy telescope distance, such catastrophes occur only ten or twelve times per century."

In addition to the chances in our favor that our sun will not be the next one to blaze forth like that above described, Professor Loomis, of Yale College, explains that such variations in the brightness of stars are not very unusual nor very infrequent, and that while the cause of these phenomena, yet a matter of conjecture among astronomers, is probably the falling of some aerial wanderer, like a comet or a meteor, into the fixed star and its consequent rapid combustion, such an event need produce no serious results necessarily, since it is a commonly received theory that the continuous intense heat of the sun is caused by the constant accession of such combustible and inflammable bodies.

A COSMOSCOPE.

Last Monday evening Prof. C. B. Boyle exhibited before a few prominent members of the American Geographical Society a very ingenious instrument of his own invention, which shows the precession of the equinoxes, the portions of the globe which are illuminated by the sun at all

seasons of the year, and, of course, in every point of its orbit. The instrument also shows the gradual variation of the inclination of the earth's axis to the ecliptic, and the circle which it would make in the heavens in the course of a grand cycle of time, 25,000 years. The following description of this philosophic application of the mechanical powers is from the inventor himself:

"The instrument was suggested by a conversation of Chief Justice Daly with the inventor upon the subject of the precession of the equinoxes, and though it was originally designed to render literal interpretation of the facts involved in that phase of our earth's relation to the sun, yet it presents with equal precision all the other facts of motion and their attendant phenomena. The sun is represented by a flame, situated a few inches above the centre of a round table upon which is figured a star chart, bounded by the twelve stars of the zodiac. The outer end of a slender arm extending from the centre is surrounded by a globe, upon which the light omitted by the flame is condensed by a lens. As this light steadily illuminates the hemisphere of the globe which is turned toward it, and as the axis about which the globe rotates is poised at the same angle of inclination to the plane of its orbit as that of the earth is to the plane of its orbit about the sun, it follows that precisely the same phases of illumination are presented upon both globes. The rising and setting of the sun, the changing lengths of day and night in different latitudes, the changes of the seasons, the long polar night and day, are all seen to occur in their proper order of succession. The eccentricity of the orbit with the sun in one of the foci of the ellipse, and the shifting of the direction of that eccentricity among the stars, is also presented. When the mimic moon is added, the eclipses of that body and of the sun present themselves, the shadow of the moon passing across the globe, first near the pole, and at each successive lunation lowers down until it passes off at the opposite pole, thenceforward the shadow of the moon passing into space clear of the globe until the combined mutations bring back the period of eclipses, thus presenting the facts successively as they occur in nature. An additional arm carries a comet so near the centre as to nearly graze the mimic sun at its perihelion, whence it departs to its aphelion distance in far off space, thence returning as before to the sun.

"At the instant the globe is passing its vernal equinox a bell is struck—a single blow, which, at each revolution of the globe about the centre, calls attention to that fact, so that the observer may see that the globe is in its equinox at the stroke of the bell, and note also that the equinox has slightly shifted its place upon the ecliptic—receded upon the star chart—gone backward in the sign of the zodiac in which it is then occurring, which slow shifting finally carries the equinoxes about the entire circle of the heavens, and, at the same time, changes the direction of the globe's axis of rotation, which returns to its original direction when the equinoxes return to their original position among the stars.—*New York Herald.*

SATURN'S DARK RING.

Mr. Trouvelot, of Cambridge, Mass., has noticed that the inner half of the dark ring is so transparent that the outline can hardly be recognized where it crosses the planet, whereas the outer half is so much more opaque that the outline of the planet can hardly be seen through it. This fact is not only remarkable in itself, but still more remarkable when we remember that until quite recently the character of the dark ring was quite different. The whole width of the ring was formerly uniformly transparent, or at least so nearly so that no difference could be recognized between the outer and inner parts of this ring. This thinning of the inner edge is probably accompanied by a gradual extension of the ring-system toward the planet.

Clerk Maxwell long since pointed out that a change of this sort was to be expected as a natural consequence of collisions taking place among the tiny moons forming this ring system. And other observations by Mr. Trouvelot shows clearly that multiplied collisions of this sort must continually occur; for he finds that from time to time the dark ring assumes an aspect showing that its substance is agglomerated in clustering masses, through which the light of the planet does not penetrate. How strange are the thoughts suggested by such changes! Within the ring itself what energy of life (so to speak) is indicated by the conflict of satellites! And as regards Saturn himself, does it not appear clear that, while such changes as these are taking place in the nearer portions of his system, he cannot yet be regarded as a completed world? We see nature's hand still at work out yonder, fashioning under the very eyes of astronomers the system of a planet once thought to have been formed even earlier than our earth.

The processes of cosmical development which were formerly so energetically disbelieved, but have now taken their place among astronomical probabilities (and almost as certainties), seem here to be actually in progress. Nature has been detected in the act, and there is good reason for believing now, what was suggested by the present writer eleven years since, that 'in the variations perceptibly proceeding in the Saturnian ring-system a key may one day be found to the law of development under which the solar system reached its present condition.—*London Spectator.*

From an examination of the observations of the minute star around which Sirius is revolving, Mr. Wilson, of Rugby, concludes that its period of revolution is two hundred years, in an orbit fifty times that of the earth. He also shows that while the sum of the masses of Sirius and its companion is about three times that of the sun, its light, according to the old method of calculation, is more than two hundred times that of the sun.

NATURAL HISTORY.

THE SEA SERPENT QUESTION REVIVED.

The recent accounts by the officers and crew of the steamship "Nestor" of an encounter with a sea serpent in the straits of Malacca, have revived the old discussions among scientific men regarding the possible existence of such an animal. Discarding the theory that the idea of the sea serpent originated in mythological ages and has been handed down from the Eddas and Sagas of the Norsemen, wherein the Midgard serpent, symbolizing really the sea itself, tumultuously encircling the whole earth in its coils, figures conspicuously, and that this sublime fancy has gradually passed from the profound northern mythology to the doubtful position of a modern superstition among credulous seamen, we will take up some later theories advanced in opposition to what appear to be the actual facts.

In the face of the most positive and seemingly indubitable testimony of experienced and careful nautical observers for hundreds of years past, the negative evidence that the researches of distinguished naturalists have failed to discover any physical traces of its existence in the past or present has been adopted by many scientific men as sufficient to warrant them in declaring the statements of alleged eye witnesses false, and it has therefore become the rule to deride all such stories as chimerical, sensational, or resulting from delusion of the witnesses.

In explaining away the statements made by sailors and others who claim to have observed sea serpents, it is customary to set forth that such objects as large pieces of sea weed floating with a head-like root projecting above the surface of the water, a shoal of porpoises tumbling along one after the other, a large horse mackerel or some other well known marine animal, have been mistaken for a serpent. In any ordinary tribunal the evidence of men accustomed to live upon the ocean and familiar with its appearances and that of all the more common animals, such as whales and porpoises, as well as that of such objects as sea weed, the low lying ranges of distant hills, etc., would be unhesitatingly received in preference to any such explanations as the above, while the theoretical impossibilities set forth by even such eminent scientists as Professor Owen would receive no consideration whatever. But as we are discussing the subject on scientific grounds, we will give in brief the points made by those who oppose Professor Owen's theories with their own.

Many fossil types of animals have been transmitted without interruption from remote geological periods to the present time; others have disappeared and reappeared at intervals more or less widely separated. As

among the latter, it has been suggested that the sea serpent may represent, in a modified form, some one of the immense marine lizards of the secondary geological formations, such as the plesiosaurus, which disappeared in the tertiary age and may have reappeared now, in similar manner as did the chimæra *percopsis*, of Lake Superior, and the soft-shelled tortoise (*tryonychidæ*) of the same geological epoch. It is also argued that the absence of fossil or other remains is not to be regarded as very strong proof of the non-existence of sea serpents, since the remains of many animals which are much more frequently seen, such as seals and whales, are rarely found, which is a very natural circumstance considering the element in which they live and in the depths of which their dead bodies might readily be concealed forever. The conclusion of the best naturalists is that the existence of the sea serpent is possible, a verity which will yet come under scientific examination, and that it may prove to be some modified type of the secondary marine lizards. As the ichthyosaurus was replaced by the whale-like cetaceans, so the plesiosaurus may have been by the zeuglodont cetaceans, of which the sea serpent may prove to be a more or less modified form. This theory also finds some support in the fact that while all the so-called sea serpents are represented by their delineators as moving by vertical undulations, which is, from the structure of their vertebræ, impossible with serpents, the plesiosaurus, from its peculiar formation and vertebral structure, was enabled to perform this motion while swimming along, as well as in thrusting its head beneath the waves in searching for its food or raising it high above them in looking for aerial prey.

Some writers believe that the leviathan of the Scriptures is an analogue of the sea serpent, and quote Job as aptly describing a marine animal with formidable teeth, compactly fitted scales, invulnerable to the slings and spears of those days, fiercely flashing eyes, phosphorescent in appearance and carnivorous in its habits.

Ancient writers, as Palladius and Solinus, allude to a huge serpent, *Odontotyrannus*, which could swallow an elephant without masticating it. Pliny also describes a similar monster as inhabiting the waters of the Ganges.

Pontpoppidan, Bishop of Bergen, in his Natural History of Norway, 1752, states that if any one doubted the existence of the great sea serpent, along the coast of Norway, he was regarded by the natives as a jester, who might as well question the existence of the eel or any common reptile. He also illustrates his book with an engraving showing an immense reptile, whose length seems to be more than thrice that of the vessel, whose head is projected above the water to half the height of the mast, and from whose mouth volumes of water are being spouted. Large wing-like fins are attached to the breast of the monster, which is covered with compact scales from head to tail.

Capt. Laurent de Ferry, in 1746, saw one of these monsters, near the port of Malde, which he says was of a gray color, with brown mouth, black eyes, and a long mane floating about its neck. Its head resembled that of a

horse, and its coils, which were very large, rose at intervals of six feet.

Mr. Maclean, a clergyman, described, in a communication to the Wernerian Society of Natural History, a monster which he saw in June, 1808, on the coast of Cali. It also moved by vertical undulations and was from seventy to eighty feet long. Some months later there was stranded upon one of the Orkney Islands the body of a monstrous serpent, which Dr. Barclay and other scientific men carefully examined and described. It was fifty-six feet long and ten feet in circumference, had a bristling mane extending nearly the whole length of its body, and was furnished with fins which measured about four feet and resembled the plucked wings of a goose.

Sea serpents have been seen by numerous witnesses along the coast of Massachusetts, near Gloucester, in 1815 and 1817; off Nahant, in 1819 and 1833, and further south, along the Atlantic Coast, in 1835 and 1848. The description of the last named, given by Capt. McQuhae, of Her Majesty's frigate Dedalus, was very minute, and was corroborated in most particulars by that of Lieut. Drummond, of the same vessel.

More recently a sea serpent was seen on the coast of Scotland, by Mr. James M. Jouass, a man of science and one not easily deceived or deluded. It was first seen by two ladies in September, 1873, again the next morning by Dr. Soutar, and the following day by Mr. Jouass himself. It is described in the *London Field* as being forty to fifty feet long, brownish yellow in color, and occasionally raising its head about four feet above the water.

In *Land and Water* for September 1, 1872, Frank Buckland gives a circumstantial account of a large serpent, about ninety-six feet long, black in color, with a flat head and probably a dorsal fin, which was seen by a visiting party, on two different occasions, in the waters of Loch Hourn, Scotland, in August, 1873. This monster also progressed by vertical undulations, which Mr. Buckland accounts for by suggesting that this may have been an immense ground-fish, with a motion in the vertical plane like the flat-fish, which occasionally comes to the surface.

The Panama *Star and Herald*, of February 16th, 1873, contains an account of a marine animal seen from the steamer Guayaquil, in the Bay of Panama. Its head was like that of a sea-horse, and its length was estimated at about twenty-five feet. A sting-ray fish, of large size, accompanied it at the time it was observed.

The description of the sea serpent observed by the officers of the steamship Nestor, referred to at the beginning of this article, is taken from the London *Spectator*, and is as follows:

"In the Straits of Malacca the sea-monster so repeatedly seen, and so repeatedly declared to be mythical, appears at last to have been carefully observed by competent witnesses. The creature was seen by the passengers and crew of the ship Nestor, on her voyage to Shanghai, and on her arrival at Shanghai the master of the ship (Mr. John Keller Webster) and the surgeon (Mr. James Anderson) made a statutory declaration of what they had seen, before a magistrate, as a mode, we suppose, of formally attesting that

they spoke in good faith. The creature (which resembles a huge salamander, only instead of being about six or eight inches long, these dimensions must be multiplied by at least seventy-five or one hundred, the body being from forty-five to fifty feet in length, the head twelve feet, and the tail, it is said, no less than 150 feet), was first seen at 10:30 on the 11th of September, fifteen miles northwest of the North Sand Lighthouse, in the Straits of Malacca. The weather was fine, the sea smooth, and the air perfectly clear. The Chinese on deck were terribly alarmed and set up a howl. The whole watch and three saloon passengers saw the creature clearly and observed its movements. It traveled for a long time about as fast as the steamer, appearing to paddle itself by the help of 'an undulatory motion of its tail in a vertical plane.' The body and tail were marked as those of the salamander are marked—with alternate bands, black and pale yellow in color. 'The head was immediately connected with the body, without any indication of a neck.' Both witnesses state positively that the only resemblance was to some creature of the frog or newt kind, while one of them (the surgeon) says the longer he observed it the more he was struck with its resemblance to a gigantic salamander. Its back was oval in form. No eyes or fins were seen, and it did not blow or spout in the manner of a whale. The greater part of its head was never seen, being beneath the surface."

The New York *Graphic* publishes a very remarkable letter, dated Honolulu, January 8, 1877, giving an account of an attack upon the brig Albatross, November 10, 1876, by an immense serpent, in latitude 21° 11′ south and longitude 122° 25′ west. When first seen, the animal was about one mile and a half to windward and making direct for the brig. The captain ordered the guns loaded and the brig kept off a little. But the serpent continued to approach rapidly and at last reached the vessel. Raising his head he struck at the windlass, without doing any harm, He was fired upon and wounded, upon which the creature withdrew and disappeared. The captain of the Albatross describes this animal as being three feet thick at the neck and about four and a half to five feet at the shoulders, with large scales all over the body, immense mouth with teeth in both jaws, the top of the head rounded up high and the neck puffed out like an East India cobra's. To make the story complete, the captain states that on the 12th November the French bark Esperance came across a dead serpent floating in the water, not far from the locality described above, which measured about 45 metres in length by two metres diameter in the largest part; was covered with large scales; had no fins, but had a broad tail like a shark.

While many of the sea serpent stories may be classed as "fishy," enough testimony of a positive and indisputable kind has been furnished to render it at least probable that a few marine monsters still inhabit the sea whose size warrants navigators in pronouncing them sea serpents. One of our most esteemed contemporary periodicals contains an article on this subject, in which the following language is used:

"And the idea of fraud in such matters is not nearly so reasonable as

many seem to imagine. Travelers are sometimes said to tell marvelous stories; but it is a noteworthy fact that in nine cases out of ten the marvelous stories of travelers have been confirmed. Men ridiculed the tale brought back by those who had sailed far to the south, that the sun there moves from right to left, instead of from left to right, as you face his midday place; but we know that those travelers told the truth. The first account of the giraffe was laughed to scorn, and it was satisfactorily proved that no such creature could possibly exist. The gorilla would have been jeered out of existence but for the fortunate arrival of a skeleton of his at an early stage of our acquaintance with that prepossessing cousin of ours. Monstrous cuttle-fish were thought to be monstrous lies till the Alecton, in 1861, came upon one and captured its tail, whose weight of forty pounds led naturalists to estimate the entire weight of the creature at four thousand pounds, or nearly a couple of tons. In 1873, again, two fishermen encountered a gigantic cuttle in Conception Bay, Newfoundland, whose arms were about thirty-five feet in length (the fishermen cut off from one arm a piece twenty-five feet long), while its body was estimated at sixty feet in length and five feet in diameter—so that the devil-fish of Victor Hugo's famous story was a mere baby cuttle by comparison with the Newfoundland monster. The mermaid, again, has been satisfactorily identified with the manatee, or 'woman-fish,' as the Portuguese call it, which assumes, says Captain Scoresby, 'such positions that the human appearance is very closely imitated.'

"As for stories of sea serpents, naturalists have been far less disposed to be incredulous than the general public. Dr. Andrew Wilson, for instance, after speaking of the recorded observations in much such terms as I have used above says: 'We may, then, affirm safely that there are many verified pieces of evidence on record of strange marine forms having been met with, which evidence, judged according to ordinary and common sense rules, go to prove that certain hitherto undescribed marine organisms do certainly exist in the sea depths.' As to the support which natural history can give to the above proposition, 'zoologists can but admit,' he proceeds, 'the correctness of the observation. Certain organisms, and especially those of the marine kind (*e. g.*, certain whales), are known to be of exceedingly rare occurrence. Our knowledge of marine reptilia is confessedly very small; and, best of all, there is no counter-objection or feasible argument which the naturalist can offer by way of denying the above proposition. He would be forced to admit the existence of purely marine genera of snakes which possess compressed tails, adapted for swimming, and other points of organization admittedly suited for a purely equatic existence. If, therefore, we admit the possibility—nay, even the reasonable probability—that gigantic members of these water snakes may occasionally be developed, we should state a powerful case for the assumed and probable existence of a natural sea serpent. We confess we do not well see how such a chain of probabilities can be readily set aside, supported as they are in the possibil-

ity of their occurrence by zoological science, and in the actual details of the case by evidence as trustworthy in many cases as that received in our courts of law.'

"When we remember how few fish or other inhabitants of the sea are ever seen compared with the countless millions which exist, that not one specimen of some tribes will be seen for many years in succession, and that some tribes are only known to exist because a single specimen or even a single skeleton has been obtained, we may well believe that in the sea, as in heaven and earth, there are more things 'than are known in our philosophy.'"

A LECTURE ON ANTS.

Sir John Lubbock lectured recently at the Royal Institution, London, on the subject of ants, to a crowded and interested audience. Briefly describing the different species, which in this country amount to some thirty, and in warmer parts of the globe to over seven hundred, the gentleman said that he had under observation thirty nests of over twenty species, no two of which were identical in habits. Most of their time is passed underground, and being essentially gregarious, it was difficult to keep them alive by themselves, at any rate without entirely altering their habits. Though much attention had been paid to their habits by distinguished naturalists, so little was at present known that the study offered a most promising field for observation and experiment. Describing the small white legless grubs constituting the larvæ of ants, and the care with which they are tended, sorted out into sizes, and carried from chamber to chamber by the workers to secure the most suitable amount of warmth and moisture, and the different sizes into which they develop to produce the queens, the males, and the workers, a differentition which is carried still further in tropical countries, he said their food consisted of small insects, honey, honey-dew, and, indeed, almost any animal of sweet vegetable substance. The small garden ant ascends bushes to seek out the aphides which infest their leaves. These insects are gently tapped with the antennæ of the ants, and then give out a drop of sweet fluid, which is at once appropriated as food by the ants. Another species of ant seeks out the aphides which infest the roots of grass, collect them, and keep them throughout the winter for the spring, an instance of forethought which needed more prudence than many savages or even many civilized persons display. Many insects lived as guests with the ants, notably beetles, which were tended and carried about like their own larvæ, probably because the beetles, like the aphides, emitted some sweet fluid that was edible by the ants. Even ants are subject to parasites, and Sir John described one of his own specimens that since the 14th of October has had a sort of mite adhering to the under side of her head. Different species of ants differ as much in their characteristics as the different races of mankind. Some were gentle and submissive, and were made slaves of

by those who were more audacious. Some are cowardly, and fly from the approach of danger, while other species are so courageous that a single specimen surrounded by enemies never attempts to fly, but fights valiantly until overpowered by numbers. Ants have long had the credit of being industrious, and with good reason, for Sir John describes, as the result of close observation, one of the workers in his own collection as being actively employed without intermission from six in the morning till 10:15 in the evening. The length of the preparatory stages of life was pretty well known, but the total duration of ant existence has yet to be determined. Sir John has workers still healthy and active which were captured in September and November, 1875, and queens which he has had under observation since December, 1874. As a rule each species lives by itself, but there are exceptions, and one species is found exclusively in the nests of largor varieties, but at present the relationship between them is not understood. One species is so dependent on slaves for the care of their young, and even for being fed, that without their slaves they cannot exist, though in the presence of ample supplies of the best food. In two of his nests Sir John found that two ants from each were deputed to come out and fetch food for the rest of the community, consisting in one case of about two hundred, and in the other of four hundred individuals. When these messengers were captured and imprisoned, two fresh messengers were appointed from each nest, the experiment being repeated several times, always with the like result. Experiments to test the intelligence of ants were not favorable to their capacity in that respect, for when cut off from their food supply by drawing back a little strip of paper which acted as a bridge, they had not intelligence to rebridge the chasm of one-third of an inch by pushing the strip of paper back. Varied experiments of a similar character resulted in the same way, except where a hole leading into a box containing food was stopped by a little mold; then the ants speedily burrowed into the mold, and found their way into the box, and again carried off the food. Sir John did not find that display of intelligence and affection which some naturalists had declared induce ants, when any of their companions are accidentally buried, to burrow down and rescue them. They do seem capable of discriminating between companions and strangers, for when a number of each were intoxicated and placed near a nest, the sober ants, after being very much puzzled at the unaccountable condition of the inebriates, carefully carried into the nest their helpless friends and pitched the strangers into a dish of water. When, however, some friends and strangers were chloroformed to death and laid near a nest the ants seemed to appreciate that the deceased were past remedy, and therefore pitched both friends and strangers indiscriminately over the edge of the table. Attempting to verify the truth of Huber's declaration that when ants had been separated for four months and then returned to their nest they were recognized and carressed by their companions, Sir John found that though there was no sign of recognition when a separated friend was returned to the nest, he was never attacked,

while a stranger being put in was always driven out or even killed. As regards the senses of ants, though Sir John believes they hear, yet they take no notice of any sound he could make, and though they undoubtedly see, they cannot have very keen sight. His experiments do not confirm the suggestion that ants are able to communicate to their companions where food has been discovered, for when single ants had been placed on food, and, going back with some to the nest, were returning with companions to the store, in every case where these pioneer ants were captured their companions wandered about helpless, and failed to find their way to the spot. Many other anecdotes of his experiments were recounted by the honorable baronet, who concluded by an interesting account of the provisions in the vegetable kingdom for preserving the pollen of flowers from the assaults of ants.

THE NIGHT-STINGING SPIDER.

"During the recent spell of warm spring weather, a well known entomologist, Mr. C. J. Bethune, M. A., discovered in Central Park, near the 7th regiment memorial monument, a pair of remarkable looking spiders. He watched them for some time, and found that they inhabited an underground mansion; that, in fact, they were burrowers. Provided, as enthusiastic entomologists invariably are, with a tin case for the reception of specimens, the two active spiders were transferred with some little difficulty to confinement, together with a portion of the sandy soil in which they had evidently passed the winter. Mr. Bethune has since been studying his prisoners, and he has now no doubt whatever about their identity. When in New Zealand he had seen a spider seemingly identical with his specimens; but the insect in question, so far as he knew, was peculiar to New Zealand, and had seldom or never been seen even in Australia. 'As I watched the pair of little wretches,' said Mr. Bethune to the writer, 'I knew I could soon test the question of their suspected identity with the New Zealanders. I had but to present my finger, but I was unwilling to incur the probable consequences of the experiment. I had a Spitz dog. I took the larger spider in a delicate wire tweezer, and I applied it to the inside of the dog's ear. The insect was nowise loath. The dog howled in agony, its head began to swell, its mouth to froth, until death relieved it in five hours. I had resolved to destroy the dog anyhow. The spider thus became the executioner of the canine and identified itself. Unquestionably the spider is the New Zealand terror. The Latrodectus katipo, or night-stinging spider, is the most dangerous creature in that distant island, and the dread of European immigrants and Maoris alike.'

"Till within late years comparatively little was known of the katipo, except on the hearsay evidence of the aborigines, whose hair-raising stories of the deadly effects of its bite excited great and natural alarm. The native name, katipo, signifies 'night-stinger'—being derived from two words,

kakati, to sting, and po, the night. The range of this spider has always been regarded as somewhat local, and in the island has been thought to be confined to the seashore. Dr. Buller, of Wellington, in a recent article on the subject, states that there is a small extent of sand hills near Woiksnae, on the west coast, noted among the natives for the abundance of katipo. 'A settler residing there, named Jenkins, assured me that he could, without difficulty, fill a quart measure in a few hours. In 1867, I collected in the same locality a considerable number, and kept them alive for several weeks in order to study their habits. And here I may mention a circumstance illustrative of the wonderful tenacity of life possessed by this formidable member of the Arachnida family. I shut up a full grown katipo in a druggist's chip-box on May 11, and placing it among other objects in my cabinet, it was overlooked and forgotten. I consequently did not open the chip-box again until October 8, following, when I found the spider alive and active, and apparently none the worse for a five months' fasting! I am inclined to consider the above case corroborative of the native account that on the approach of cold weather the katipo retires to a cell underground and passes the winter in a torpid state, and that in this condition it may be handled with perfect impunity.'

"It seems idle to speculate how these venomous insects reached this country. We know that ships from New Zealand are continually reaching our shores, and that during the early months of the Centennial year this communication was exceptionally large. It is more than likely, however, that the Latrodectus katipo has been colonized among us for some years. A single pair produces an incredible offspring in a single season; and our sandy soil and seashores, like Coney Island, may soon be rendered more dangerous than an Indian jungle or a Florida swamp by this deadly and industrious insect."—*New York Mercury.*

SCIENTIFIC MISCELLANY.

SCIENCE AND RELIGION.

It is generally supposed by the average thinker that all religious persons regard the doctrines of Darwin and Huxley as at least akin to atheism, if not atheism itself, and it may surprise some of our readers to learn that many wise and good Christians accept the development theory as probably correct and demonstrable, and one which may be believed in without any decrease or modification of their faith in God and Christianity. Others again seem to regard every new theory or discovery in science as an at-

tack aimed at religion, and feel themselves called upon to rush impetuously to its defense, whether properly and sufficiently armed to render effective service or not.

For the benefit and information of this latter class, which was greatly agitated by the announcement that Prof. Huxley was about to deliver a series of lectures upon evolution, in New York, during the past winter, the *Independent* offered a few suggestions, showing as nearly as possible the exact position of scientific Christians upon this subject. The points made were as follows:

"1. Evolution and Darwinism in its strict sense are not the same thing. Darwinism is one theory of evolution, that of Charles Darwin. According to it each living organism has in it capacity of producing its like within a narrow range of very slight, almost inappreciable variation in any and every part and direction. This is but an evident and patent fact. It also holds that the surroundings of every living creature, its environment, kill off early those which are less adapted to fight their own way, leaving those which have varied favorably to produce offspring like themselves with further minute variations. Darwinism holds that this is sufficient to account for all the origination of species. But there are other theories of development. There are scholars who hold that like does not always produce like, and who point to well-known instances in which variation has proceeded by a leap, and in which some marked variety, if not species, has been known suddenly to rise. In this they see no law, but think they recognize the guidance of some superior power. This we give as one example of a development theory which is not Darwinism; there are others. In the view of those who hold them, Darwinism errs not in its two principles, but in its assumption that these are all the laws of variation. Even Darwin affords the storehouse out of which the facts for other theories are gathered, and in his later works recognizes other laws of variation.

"2. Let it not be forgotten that many wise and reverent Christians either warmly advocate or willingly accept development. At the present day nearly all students of the laws of life are Darwinists in the broader sense of the word. They are believers in the origination of species by birth and development, and not by special creation. Of these a fair proportion, as large a proportion as of lawyers or of statesmen, believe in God and in Christianity. They are an exceptionally intelligent body of men, thinkers by careful training, and they believe that one can accept heartily the cardinal truths of our faith, and yet hold that man and all animals and plants are developed from primordial vital germs. Some respect should be paid to such men. They deserve it. They may be wrong in holding both to development and religion, but the presumption is that they are not. Their position is re-enforced by not a few of our most intelligent theologians, of whom President McCosh may be taken as a type, who are equally emphatic in holding that the two positions may be consistently held.

"3. Let it not be forgotten that in this matter the theologians are at a

disadvantage. They do not have the final word in this matter of development. The belief of the world is to be settled utterly without their advice. Not what they say, but what the scientists say, is to conclude this debate. Whether species have been produced by development or by creation is a question of fact, to be settled purely by scientific evidence. It is not a matter of philosophy or of morals, to be decided by consulting the psychical or ethical consciousness; nor is it a matter of revelation, to be decided by consulting the Word of God. For the conclusions we must examine to see whether new species are being now produced about us, and whether the records which the earth has preserved of its own history tell us anything on this subject. This is the task of the naturalist, and not of the religionist; and, so far as we can judge at present, the answer which the naturalist will give is in favor of the new theory. Not many years ago the answer would have been just the contrary. Geologists were catastrophists, and thought they had evidence that sudden changes had occurred in the condition of the earth, and that one thousand utterly new creatures had more than once been simultaneously introduced. Then geology was the record of miracles one hundred times more stupendous than any recorded in the Gospels; but now the tide has turned, and another view is generally taken. There will be a sifting of evidence and a settlement of judgment, which will be final, and which theologians will have to accept. At present, we say, it looks extremely probable that the result will be the victory of evolution. Now, with this probability, or even with a possibility of it, it is not generalship for those who set themselves up as the special defenders of revelation to make it absolutely inconsistent with evolution.

"4. Evolution does not deny God. Nearly all evolutionists are theists. We acknowledge that it appears to remove God a little further off, but that is only in seeming. God may be just as active and present in law as he is in miracle. Be it remembered that every single conquest which science has made in reducing phenomena under the sway of law has appeared to many to put God at a greater distance. But by it God's government has only been made more orderly, and his own character more glorious.

"5. Let it be remembered that many wise men hold with Prof. Asa Gray that the argument for the existence of God drawn from design is not destroyed or even weakened by the theory of evolution. They see a designer in the law and progress of the evolution of an eye or a hand as clearly as in its absolute creation. Now allow us a God, and revelation is an easy deduction. That evolution is inconsistent with the literal prosaic interpretation of the story of Adam created *de novo* out of dust, and Eve out of his rib, we do not deny; but the story of Eden is so true in its essence, and yet carries so many signs of a symbolic or poetical meaning that this fact need disturb none but those who will not listen to reason. It is even true that the story of the fall of man in its most literal interpretation, with the doctrine of imputation of Adam's sin included, is not utterly inconsistent with development, though it is with Darwinism. None but the most

rigid defenders of an unchangeable faith, settled to its minutiæ some centuries ago, need fear the doctrine.

"We offer these thoughts by way of caution. Not that we believe that religionists need warning more than scientists, but because we speak to the former rather than to the latter."

There are men who, like Rev. John H. Hopkins in his lecture on the "True relations between Science and Religion," take the ground that nothing is more untrue or unfortunate than the idea that these two things are antagonistic. The theologian expounds the revealed Word of God, the scientific man is simply an interpreter of his wonderful works for our information, and in many respects a teacher of the theologian. As a rule, scientific men are candid, fair-minded seekers after truth, and give to the world merely the results of their researches and what they believe to be the necessary and logical outgrowth therefrom, building up their theories on the basis of the "coincidence of observed facts with theoretical requirements," and remorselessly abandoning them when convinced of their insufficiency or untenability.

The pursuit of scientific subjects stimulates thought, and even when scientists fail of finding what they are immediately in search of they frequently make other discoveries which are of vast benefit to mankind, and give us a more exalted conception of the Deity. Science and religion are inseparable and even essential one to the other. No man need fear that the truth will be obscured by the revelations of science, even should all the scientists of the world combine to accomplish this object. "The truth cannot conflict with God's Word however much it may conflict with man's interpretation of it."

Having indicated above some of the admitted points of agreement between advanced and learned religionists and the advocates of the evolution theory, we quote from Huxley's lecture upon "The Demonstrative Evidence of Evolution," some of the more interesting features of his demonstration of the gradual successive changes in animal structure during past ages:

"The proof of evolution cannot be complete until we have obtained demonstrative evidence, and that evidence has of late years been forthcoming in considerable and continually increasing quantity. Indeed, it is somewhat surprising how large is the quantity of that evidence, and how satisfactory is its nature, if we consider that our obtaining such evidence depends upon the occurrence in a particular locality of an undisturbed series deposited through a long period of time, which requires the further condition that each of these deposits should be such that the animal remains imbedded in them are not much disturbed, and are imbedded in a state of great preservation. Evidence of this kind, as I have said, has of late years been accumulating largely, and in respect to many divisions of the animal kingdom. But I will select for my present purpose only one particular case, which is more adapted to the object I have in view, as it relates to the origin, to what we may call the pedigree, of one of our most familiar do-

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mestic animals—the horse. But I may say that in speaking of the origin of the horse I shall use that term in a general sense as equivalent to the technical term *Equus*, and meaning not what you ordinarily understand as such, but also asses and their modifications, zebras, etc.

"Without attempting to take you very far into the region of osteological detail, I must nevertheless—for this question depends upon the comparison of such details—trouble you with some points respecting the anatomical structure of the horse, and more especially with those which refer to the structure of its fore and hind limbs. But I shall only touch upon those points which are absolutely essential to the inquiry that we have at present put. Here is the fore-leg of a horse. The bone which is cut across at this point is that which answers to the upper-arm bone in my arm, what you would call the humerus. This bone corresponds with my fore-arm. What we commonly term the knee of the horse is the wrist; it answers to the wrist in man. This part of the horse's leg answers to one of the human fingers, and the hoof which covers this extended joint answers to one of my nails.

"You observe that, to all appearance, there is only one bone in the fore-arm. Nevertheless, at the upper end I can trace two separate portions; this part of the limb, and the one I am now touching. But as I go farther down it runs at the back part into the general bone, and I cease to be able to trace it beyond a certain point. This large bone is what is termed the radius, and answers to the bone I am touching in my arm, and this other portion of bone corresponds to what is called the ulna. To all appearance in the forearm of the horse the ulna is rudimentary, and seems to be fused into one bone with the radius.

"It looks thus as if the ulna, running off below, came to an end, and it very often happens in works on the anatomy of the horse that you find these facts are referred to, and a horse is said to have an imperfect ulna. But a careful examination shows you that the lower extremity of the ulna is not wanting in the horse. If you examine a very young horse's limb you will find that this portion of the bone I am now showing you is separable from the rest, and only unites as the animal becomes older, and this is, in point of fact, the lower extremity of the ulna; so that we may say that in the horse the middle part of the ulna becomes rudimentary and unites with the radius, and that the lower extremity of the ulna is so early united with the lower extremity of the radius that every distinct trace of separation hasv anished in the adult.

"I need not trouble you with the structure of this portion that answers to the wrist, nor with a more full description of the singular peculiarities of the part, because we can do without them for the present, but I will go on to a consideration of the remarkable series of bones which terminates the fore-limb. We have one continuous series in the middle line which terminates in the coffin-bone of the horse upon which the weight of the fore-part of the body is supported. This series answers to a finger of my hand,

and there are good reasons—perfectly valid and convincing reasons, which I need not stay to trouble you with—which prove that this answers to the third finger of my hand enormously enlarged.

"And it looks at first as if there were only this one finger in the horse's foot. But, if I turn the skeleton round, I find on each side a bone shaped like a splint, broad at the upper and narrow at the lower end, one on each side. And those bones are obviously and plainly and can be readily shown to be the rudiments of the bones which I am now touching in my own hand —the metacarpal bones of the second and of the fourth finger—so that we may say that in the horse's fore-limb the radius and ulna are fused together, that the middle part of the ulna is excessively narrow, and that the foot is reduced to the single middle finger, with rudiments of the two other fingers, one on each side of it. Those facts are represented in the diagram I now show you of the recent horse. Here is the fore-limb (pointing to the diagram), with the metacarpal bones and the little splint-bones, one on each side. It sometimes happens that by way of a monstrosity you may have an existing horse with one or other of these toes—that is provided with its terminal joints.

"Let me now point out to you what are the characteristics of the hind-limb. This (pointing to the diagram) is the shin-bone of the horse, and it appears at first to constitute the whole of the leg. But there is a little splint at this point which is the rudiment of the small bone of the leg—what is called the fibula—and then there is connected with the lower end of the tibia a little nodule which represents the lower end of the fibula, in just the same way as that little nodule in the fore-limb represents the lower end of the ulna. So that in the leg we have a modification of the same character as that which exists in the fore-limb—the suppression of the greater part of the small bone of the leg and the union of its lower end with the tibia. So, again, we find the same thing if we turn to the remainder of the leg. This (showing) is the heel of the horse, and here is the great median toe, answering to the third toe in our own foot; and here we have upon each side two little splint bones, just as in the fore-limb, which represent the rudiments of the second and the fourth toes—rudiments, that is to say, of the metatarsal bones, the remaining bones having altogether vanished. Let me beg your attention to these peculiarities, because I shall have to refer to them by-and-by. The result of this modification is, that the fore and hind limbs are converted into long, solid, springy, elastic levers, which are the great instruments of locomotion of the horse.

"I think that will suffice as a brief indication of some of the most important peculiarities and characteristics of the horse. If the hypothesis of evolution is true, what ought to happen when we investigate the history of this animal? We know that the mammalian type, as a whole—that mammalian animals—are characterized by the possession of a perfectly distinct radius and ulna, two separate and distinct movable bones. We know, further, that mammals in general possess five toes, often unequal, but still as

completely developed as the five digits of my hand. We know, further, that the general type of mammal possesses in the leg, not only a complete tibia, but a complete fibula—a complete, distinct, separable bone. Moreover, in the hind-foot we find, in animals in general, five distinct toes, just as we do in the fore-foot. Hence it follows a differentiated animal like the horse, must have proceeded by way of evolution or gradual modification from a form possessing all the characteristics we find in mammals in general. If that be true, it follows that if there be anywhere preserved in the series of rocks a complete history of the horse, that is to say of the various stages through which he has passed, those stages ought gradually to lead us back to some sort of animal which possessed a radius and an ulna, and distinct complete tibia and fibula, and in which there were five toes upon the fore-limb, no less than upon the hind-limb. Let us turn to the facts and see how they bear upon the requirements of this doctrine of evolution.

"In the earlier Pliocene and later Miocene epoch, in deposits which belong to that age, and which occur in Germany and in Greece, in India, in Britain and in France, we find animals which are like horses in all the essential particulars which I have just described, and the general character of which is so entirely like that of the horse that you may follow descriptions given in works upon the anatomy of the horse upon the skeletons of these animals. But they differ in some important particulars. There is a difference in the structure of the fore and hind limb, and that difference consists in this, that the bones which are here represented by two splints, imperfect below, are as long as the middle metacarpal bone, and that attached to the extremity of each is a small toe with its three joints of the same general character as the middle toe, only very much smaller, and so disposed that they could have had but very little functional importance, and that they must have been rather of the nature of the dew-claws such as are to be found in many ruminant animals. This *Hipparion*, or European three-toed horse, in fact presents a foot similar to that which you see here represented, except that in the European *Hipparion* these smaller fingers are farther back, and these lateral toes are of smaller prorortional size.

"Now let us go a step farther back to the middle and older parts of which are called the Miocene formation. There you find in some parts of Europe the equine animals which differ essentially from the modern horse, though they resemble the horse in the broad features of their organization. They differ in the characters of their fore and hind limbs, and present important features of differnce in the teeth. The forms to which I now refer are what constitute the genus *Anchitherium*. We have three complete toes; the middle toe is smaller in proportion, the inner and outer toes are larger, and in fact large enough to rest upon the ground, and to have functional importance—not an animal with dew-claws, but an animal with three functional toes. And in the fore-arm you find the ulna a very distinct bone, quite readily distinguishable in its whole length from the radius, but still pretty closely united with it. In the hind-limb you also meet with three

functional toes. The structure of the hind-foot corresponds with that of the fore-foot; but in the hind-leg the fibula is better developed. In some cases I have reason to think that it is complete; at any rate this lower end of it is quite distinctly recognizable. In this succession of forms you have exactly that which the hypothesis of evolution demands. The history corresponds exactly with that which you would construct *a priori* from the principles of evolution. An alternative hypothesis is hardly conceivable, but the only one that could be framed would be this, that the *Anchitherium*, the *Hipparion*, and the horse, had been created separately and at separate epochs of time.

"Of late years there have been discovered on this continent—in your Western Territories—that marvelous thickness of tertiary deposits to which I referred the other evening, which gives us a thickness and a consecutive order of older tertiary rocks admirably calculated for the preservation of organic remains, such as we had hitherto no conception of in Europe. They have yielded fossils in a state of preservation and in number perfectly unexampled. And with respect to the horse, the researches of Leidy and others have shown that numerous forms of that type are to be found among these remains. But it is only recently that the very admirably contrived and most thoroughly and patiently worked-out investigations of Prof. Marsh have given us a just idea of the enormous wealth and scientific importance of these deposits. I have had the advantage of glancing over his collections at New Haven, and I can truly and emphatically say that, so far as my knowledge extends, there is nothing in any way comparable, for extent, or for the care with which the remains have been got together, or for their scientific importance, to the series of fossils which he has brought together. (Applause.) This enormous collection has yielded evidence of the most striking character in regard to this question of the pedigree of the horse. Indeed, the evidence which Prof. Marsh has collected tends to show that you have in America the true original seat of the equine type—the country in which the evidence of the primitive form and successive modifications of the horse series is far better preserved than in Europe. The succession of forms which he has brought together shows, in the first place, the great care and patience to which I have referred. Secondly, there is this Pliocene form of the horse (*Pliohippus*); the conformation of its limbs presents some very slight deviations from the ordinary horse, and with shorter crown of the grinding teeth. Then comes the form which represents the European *Hipparion*, which is the *Protohippus*, having three toes and the forearm and leg and teeth to which I have referred, and which is more valuable than the European *Hipparion* for this reason: it is devoid of some of the peculiarities of that form—peculiarities which tend to show that the European *Hipparion* is rather a side branch than one in the direct line of succession. Next comes the *Miohippus*, which corresponds pretty nearly with what I spoke of as the *Anchitherium* of Europe, but which has some interesting peculiarities. It presents three toes—one large median and two lateral ones; of the toe

which answers to the little finger of the human hand, there is only a rudiment. This is, however, as far as European deposits have been enabled to carry us with any degree of certainty in the history of the horse. In the American tertiaries, on the contrary, the series of equine forms is continued down to the bottom of the Eocene. The older Miocene form, termed *Mesohippus*, has three toes in front and a large splint-like rudiment representing the little finger, and three toes behind. The radius and ulna are entire, and the tibia and fibula distinct, and the teeth are anchitheroid with short crowns.

"But the most important discovery of all is the *Orohippus*—which comes from the lower part of the Eocene formation, and is the oldest member of the equine series known. Here we have four complete toes on the front-limb, three toes on the hind-limb, a well-developed ulna, a well-developed fibula, and the teeth of simple pattern. So you are able, thanks to these great researches, to show that, so far as present knowledge extends, the history of the horse-type is exactly and precisely that which could have been predicted from a knowledge of the principles of evolution. And the knowledge we now possess justifies us completely in the anticipation that when the still lower Eocene deposits and those which belong to the Cretaceous epoch have yielded up their remains of equine animals, we shall find first an equine creature with four complete toes and a rudiment of the innermost toe in front, and probably a rudiment of the fifth toe in the hind-foot. (Since this lecture was delivered, Prof. Marsh has discovered in the lowest Eocene deposits of the West a new genus of equine mammals (*Eohippus*), which corresponds very nearly to this description.—*American Journal of Science*, November, 1876.) In still older forms the series of the digits will be more and more complete, until we come to the five-toed animals, in which most assuredly the whole series took its origin.

"That is what I mean, ladies and gentlemen, by demonstrative evidence of evolution. An inductive hypothesis is said to be demonstrated when the facts are shown to be in entire accordance with it. If that is not scientific proof, there are no inductive conclusions which can be said to be scientific. And the doctrine of evolution at the present time rests upon exactly as secure a foundation as the Copernican theory of the motions of the heavenly bodies. Its basis is precisely of the same character—the coincidence of the observed facts with theoretical requirements."

FAMILIAR TALK CONCERNING THE TEETH.

I have so many times been asked by my patients why it is possible for a tooth to ache after the nerve has been killed that I propose to try to explain to the readers of the *Journal*, in as simple a manner as possible, avoiding all technicalities, why such a seeming contradiction can occur. If a longitudinal section be made of a tooth, a cavity nearly corresponding in shape

to the external contour of the tooth will be found. This cavity is prolonged into the root, or roots, if there be more than one, and opens by a minute orifice at the extremity of each. This is called the *pulp cavity* or *chamber*, while those portions extending into the roots are distinguished by the name of *pulp canals*. This pulp cavity is occupied by a highly vascular and nervous tissue, the *dental pulp*, which is continuous through the opening at the end of the root with the vessels and nerves which supply the teeth and adjacent parts. From this dental pulp, improperly called the nerve, the tooth derives most of its life. The popular idea that the pulp of a tooth is a nerve is not correct; on the contrary, it is composed of much the same elements as any vital tissue. It is from this pulp that the hard tissues of the tooth are developed, it being originally of nearly the size of its individual tooth, growing smaller as the tooth becomes more fully developed, until at last it occupies only a small portion of the tooth. The exterior of the pulp corresponds in shape with that of the tooth, so that if it be isolated completely from the tooth, its shape will indicate to which kind of tooth it belonged. Its blood-vessels and nerves are numerous, being connected with the general system by passing out through the minute orifice at the end of the root.

There is, however, another source from which the tooth derives life, namely, from its *peridontium*. Covering the roots of teeth is a delicate membrane containing an abundance of blood-vessels and nerves. It is intimately connected with the gum; also with a corresponding membrane covering the adjacent bone, as well as all bones in the body. For a more familiar term we will call it the *root membrane;* its correct name is *peridontium*, which signifies, "around a tooth." On bones, however, it is called periosteum. From this root membrane the tooth derives enough life so that if the pulp die from any cause the tooth will still be retained; which would not be the case if all its nutriment came from the pulp, for in that case, should the pulp die, the tooth would become a foreign substance, and Nature would at once set her forces at work to remove it, as she would a thorn or any other alien intruder. Thus we see that though the pulp is dead, there is still life remaining in the tooth, owing to the nourishment it receives from this root membrane; otherwise the tooth would not remain in its bony socket. It is from an inflammation of this root membrane (peridontium) that the pain arises when you have a toothache from a tooth in which the pulp has been devitalized; and I will now proceed to explain the causes which excite this irritation.

When from any cause the pulp of a tooth "gives up the ghost," what happens? The pulp, being dead, of course decomposes; and if allowed to remain in the tooth, the gasses arising from this decomposition must find a means of exit. If a cavity of decay exists, freely open (for pulps will die sometimes when not exposed by decay, as I will explain hereafter), the gases arising from the dead pulp will escape through the cavity, and no trouble results. But should this cavity be closed, either by the impaction

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of food, a filling, or any other cause, the gases, finding no other vent, are forced through the minute orifice at the end of the root, where the vessels entered which supplied it with life, irritating the root membrane of the tooth and the surrounding parts. This irritation causes inflammation, and as this progresses pus is formed.

The first indication we have of this variety of toothache, is a slight soreness on shutting the teeth together, or on striking the affected tooth. Soon the soreness increases, the tooth feels as if it was more prominent than the others, and one has a desire to be continually feeling of it, to see how things are progressing.

The pain is dull, throbbing and, owing to the parts being confined by hard, bony walls, severely intense, the whole jaw sympathizing. How will this state of things end? In one of two ways. Sometimes, in persons of good constitution, the trouble will after a while pass away, but, as a general rule, pus will keep forming, the face swelling, and finally, after almost unbearable agony, the pus will work its way through the bone and soft parts, forming what is known as a gum-boil (alveolar abscess), which at last breaks, and thus for a time will the trouble end. This is what is familiarly known as an ulcerated tooth.

What causes the death of the pulp? The most frequent cause is the application of some medicament by the dentist, to destroy it. This ought never to be done if it can be avoided, as there is in the majority of cases a much better way of treating them, if they are not too much diseased; namely, by carefully cleaning the parts, washing with tepid water, and protecting them with a soft, non-irritating filling, as every thoroughly educated dentist knows how to do. There are other causes, such as severe blows received upon the teeth, too close contact of metallic fillings, application of arsenic to allay sensitiveness in cavities of decay—which should never be done unless it be for the express purpose of devitalizing the pulp—and several other causes which I have not space here to name.

As it is often necessary to destroy these pulps, what should be done to guard against toothache of this variety? After the life of a pulp has been destroyed, by the application of medicine to it, or any other cause, it should be hardened and withdrawn from its cavity—which is not a painful operation—the parts thoroughly disinfected, and the cavity carefully filled. If teeth are treated in this way, the chances of trouble are greatly lessened, and they may be retained as useful organs for many years, and perhaps for a life-time. What shall we do if this trouble does arise? Consult a competent dentist, not one who has picked up a little knowledge of teeth, and is a mere extractor and plugger of these organs, but one who has been thoroughly and scientifically educated for his calling, and he will know what to do. In case for any reason this is impossible, you *may* be able to relieve yourself.

In the first place do not delay in hope that the tooth may feel better, but attend to it at once. Remove, if you can, all foreign matter from the cavi-

ty, thoroughly washing it with tepid water, and get an opening into the pulp chamber. This alone will often cure it. Paint the gum freely all around the tooth with strong tincture of iodine, first drying off the moisture from the gum. Hold ice-cold water or lumps of ice continually in the mouth, but should you start on this cold water method of treatment you must keep it up for several hours, or it will be worse than useless. Hot foot-baths and saline cathartics. Let the tooth alone, do not keep feeling of it, thus keeping up the irritation which you are trying to allay. Remember that this form of treatment is not applicable to an exposed living pulp, but only in cases where this organ is dead. Cold water applied to an inflamed living pulp would only increase your agony. Should you find that you cannot arrest the inflammation after sufficient trial, you will have to take the other course, and that is, to hasten suppuration by warm applications *directly to the part*. For this purpose nothing is better than a split fig, roasted and laid on the gum. Warm fluids held in the mouth will sometimes afford relief. But it is wiser to go at once to a competent dentist, as serious trouble often arises from this form of disease. Never on any consideration apply poultices on the outside of the face, for should the abscess point and break there, a permanent and unsightly scar would be the result.

In closing I would say that as "an ounce of prevention is better than a pound of cure," it would be much better to attend to your teeth in time, before the pulps become exposed, and save your teeth and yourself all this pain and trouble. You will never find any artificial teeth that will be the source of as much comfort as your own natural organs properly taken care of.—GEO. L. PARMELE, M. D., *in Boston Journal of Chemistry.*

THE FRENCH VINE DESTROYER.—A correspondent of the *Pall Mall Gazette*, writing from Cognac under date of October 13, says: "Five years ago the French Minister of Agriculture offered a prize of 20,000 francs for the discovery of a means of ridding France of so disastrous a scourge (the phylloxera). Small as the prize was in comparison with the great interest at stake, it was sufficient to quicken the zeal alike of savans and empirics. Insecticide powders innumerable were brought into requisition; manure mixed with plaster, lime, sulphur, salt, soot and tar was successively tried; experiments were made with carbolic, arsenious and sulphuric acids, with sulphuret of carbon, creosote, ammonia and petroleum; the roots of the vines, too, were swaddled in green tobacco leaves, and in some localities attempts were made to eradicate the pest with fire. Some of these agents occasionally revived ailing plants, but failed to annihilate the phylloxera. Out of one hundred and forty supposed remedies which the Agricultural Society of Montpelier put to test, thirty-four produced some slight beneficial results, nine either injured or killed the vines, and the remaining ninety-seven exercised no influence whatever either for good or evil.

"Submersion of the vines under water appeared to be the only economic

remedy that has been attended with real success. Efforts were made to apply this remedy on a large scale; and at a session of the Societe des Agriculteurs de France, M. Aristide Dumon, a well-known engineer, proposed to draw off a quantity of water from the Rhone, in the neighborhood of Condrieu, near where the famous Cote Rotie is grown, and by means of a canal to inundate some 20,000 acres of vineyards along the Cotes du Rhone. The subject was brought before the National Assembly, but the Budget Committee rejected the proposal on the plea of there being no funds available for digging the canal in question. Three years ago M. Planchon, a distinguished French naturalist, visited the United States, where he learned that certain species of American vines are left untouched by the phylloxera —thanks to the activity of a parasitic insect termed the "cannibal," which feeds upon the phylloxera with insatiable voracity. M. Planchon, delighted with his discovery, brought back with him a large number of these so-called cannibals, but, unluckily, did not succeed in multiplying them as he had hoped, so that the phylloxera is enabled to continue its ravages unchecked. Some time ago the French Government, alarmed at the extent of the devastation, offered a prize of 300,000 f. for an efficacious and economical means of arresting the further progress of this scourge of the vine; but although many have competed it still remains, and is likely to remain unawarded.

Hot Water for Injuries and Bruises.—The New York *Medical Journal* reports this case: The patient was engaged in a machine shop, and while his hand was upon the anvil of a trip-hammer, the hammer—weighing 700 pounds—fell. It so happened that a file was on the anvil, and in this way the force of the hammer was arrested about half an inch before it reached the bed. When the hand was examined it was found that the whole palm was a mass of pulp. The metacarpal bones were comminuted extensively, and there was, apparently, but small chance of saving the hand. It was, however, placed in hot water, and kept there for two or three weeks, and then taken out and dressed. In three months the patient was sufficiently well to leave the hospital, and now—nine months after the accident—he is able to move the fingers and has quite a useful hand. Bruises and injuries do much better when treated with hot than with cold water. The temperature should be about 103° Fahrenheit. Another case is reported of compound fracture and discoloration of the ankle joint, in which the proximate end of the first metatarsal bone protruded from the foot. The dislocation was reduced and the foot placed in hot water. At the end of a week it was taken out and dressed in the ordinary manner. The foot is now doing well and promises a good return.

Cold Baths in Typhoid Fever.—Dr. Mayet has lately furnished in the *Gazette Hebdomadaire* some interesting statistics from Lyons hospitals with regard to the treatment of typhoid fever with cold baths. It is shown that

the patients thus treated, though taken from amongst those most seriously attacked, have always, since 1874, presented a less mortality than those who have been treated otherwise. He also points out to his colleagues that the mortality of typhoid patients has been increasing in the hospitals as the number of patients subjected to baths has been diminished.

REMEDY FOR SANDCRACKS.—The *English Live Stock Journal* published the following recipe for a preparation by means of which sandcracks or fractures in hoof or horn may be durably cemented up: Take one part of coarsely powdered gum-ammonia and two parts of gutta-percha the size of a hazel nut. Put them in a tin-lined vessel over a slow fire, and stir constantly until thoroughly mixed. Before the thick resinous mass gets cold mould it into sticks like sealing wax. The cement will keep for years, and when required for use it is only necessary to cut of a sufficient quantity, and remelt it again for application. The only precaution necessary for its successful application is the careful removal of all grease by spirits of sal-ammonia, sulphite of carbon or ether.

EDITORIAL NOTES.

Owing to an unexpected absence in the latter part of March we were unable to get the second number of the "REVIEW" out in that month, hence date it April. Such interruptions are very annoying, but as the "REVIEW" is not a newspaper no special harm has been done by the delay. Hereafter it is hoped that we will be able to issue each number promptly at the proper date.

THE POPULAR SCIENCE MONTHLY, April, 1877. D. Appleton & Co., New York. 128 pages. Fifty cents.

Promptly on time, this ever welcome journal greets us with a most attractive appearance, both in typography and paper, while to scientific readers the following table of contents presents a rare intellectual feast: A Combat with an Infected Atmosphere, by Prof. John Tyndall, F. R. S., illustrated; Relations of the Air to Our Clothing, by Dr. Max von Pettenkofer; Audubon's Lily Rediscovered, by Prof. Samuel Lockwood; The Plant-Eaters of North America, by Prof. Sanborn Tenney, illustrated; the Science *vs.* the Art of Chemistry, by Prof. Ira Remsen; Vital Statistics, by Charles P. Russel, M. D.; World-Creations, by C. C. Merriman, Esq.; Accoutrement of a Field Geologist, by Prof. Geikie, F. R. S., illustrated; On the

Annihilation of the Mind, by Prof. John Trowbridge; the First "Popular Scientific Treatise," by Prof. S. P. Langley; the Ball-Paradox, by Thomas S. Crane, C. E., illustrated; Laboratory Endowment, by Prof. F. W. Clarke; the Origin and Curiosities of the Arabic Numerals, by D. V. T. Qua; the Scientific Labors of William Crookes, with portrait; Correspondence; Editor's Table: International Copyright—the Order of Nature, etc.; Literary Notices: Smith's Notes on Life Insurance— Ferrier's Functions of the Brain —Barrett's Carlyle Anthology—New Encyclopædia of Chemistry, etc.; Popular Miscellany: Tyndall and Roberts on Spontaneous Generation—the Phenomena of Hypnotism—Further Experiments with Putrescible Fluids —a Solar Distillery—Meteorological—Preservation of Ice in the Sick Room, etc; Notes.

GRAY'S ATLAS OF THE UNITED STATES AND THE WORLD. Published by Milton R. Brown & Co. Compiled and drawn from the latest and most reliable authorities by O. W. GRAY & SON, Philadelphia, Pa. Sold by subscription by A. BROWN, Kansas City, Mo. $16.00.

This is the most complete and comprehensive atlas we have ever seen, comprising, as it does, over eighty imperial folio pages, showing counties, towns, river, lakes, mountains, railroads, canals, etc. There are six maps of the United States alone, showing separately the railroad system, the climatology, the geology, the zoology, the botany and the history. Equal care is taken to show clearly and fully the physical details of other countries, while the letter-press comprises a general description of the world, its form, density, temperature, meteorology, etc., etc., together with a climatological description of the United States, by Lorin Blodgett; a geological description by Prof. Chas. H. Hitchcock, etc., etc., besides distance, population and other statistical tables and reports of all kinds. Persons in need of a new atlas can hardly hope to find a better one than this, and the price is very reasonable, considering the size and quality of the work.

PUBLICATIONS RECEIVED.—Mineral Resources west of the Rocky Mountains, 1875; Seventh Annual Report of R. W. Raymond, United States Commissioner of Mining Statistics; Eighth Annual Report on the Noxious, Beneficial and Other Insects of the State of Missouri, by Charles V. Riley, State Entomologist; The American Meteorologist, February, 1877, Prof. J. H. Tice, editor, St. Louis, Mo.; Popular Science Monthly, April, 1877, Appleton & Co., New York; Boston Journal of Chemistry; Address before the St. Louis Academy of Science, by C. V. Riley, St. Louis, Mo.; The *Miami Republican*, Paola, Kas.; *Bates County Record*, Butler, Mo.